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THE ILFORD RAILWAY COLLISION.

LIEUT-COL. VON DONOP'S report on the collision which occurred on the Great Eastern Railway at Ilford, on the first day of the year, has now been issued, and, as was, perhaps, to be expected from the evidence given at the inquest and from the character of the signalling apparatus in use, the Colonel comes to the conclusion that there can be no doubt the driver did not exercise sufficient care in noting the positions of his signals "when approaching Ilford," and "that it is entirely to this want of care on his part that this collision must be attributed." There are, however, some points arising from the report which are of very considerable interest.

In dealing with the lay-out of the station and signal-boxes at Ilford, Colonel von Donop gives the distance between the East and West boxes as just over 250 yards. This being the case, it would have been thought that passenger trains would have been dealt with under the "400 yards rule," as laid down in the third paragraph of Rule 4 of the Regulations for Train Signalling by Block Telegraph on Double Lines of Railway. This paragraph reads as follows:—"When the home signal at the signal-box in advance is less than 400 yards ahead, permission for a train to approach must not be given to the signal-box in the rear until permission for the train to proceed has been received from the signal-box in advance, except in the case of a train not conveying passengers, which may be accepted under Regulation 5, when the advance section is not occupied by a train conveying passengers."

In his evidence, the signalman on duty at the East box at the time said: "I remember being offered the Clacton train from Ilford carriage-sidings signal-box (from which the Clacton train was approaching) at about 8.37 a.m. I accepted it at once. At the same time I also offered it to the West signal-box. He did not accept it." The procedure seems to have been in this case exactly the reverse of that laid down by the rule quoted. Had the rule been carried out, the signals at the Ilford carriage-sidings signal-box would have been kept against the train, and an additional check against over-running at the critical point would have been interposed. It does not necessarily follow that the driver would have run past the latter signals: from his evidence it appears that he had noticed other signals at danger, since he said in giving his evidence: "after leaving Shenfield we were just checked at Brentwood." A driver is entitled to the protection of all the signals which a due observance of the rules of signalling afford him. In this case it would seem that full protection has hardly been given.

The signalman at the East box made no mention in his evidence on January 5th of having received from the West box the blocking-back signal, which the signalman at the latter box said he had sent, but when further examined on February 2nd he remembered the circumstance. What was the object of giving this signal, or what gave rise to the necessity, is not made apparent. That such a signal should be given seems very strange, since it was inapplicable to the conditions and the place. The rule for blocking back says: "Trains or engines approaching a junction on a line converging to a fouling point, or when leaving an independent line, or a siding, to at once proceed on their journey, or crossing directly over another running line are exempted from the operation of blocking back, and must be dealt with under Regulation 4." The blocking-back signal requires permission from the man receiving it before it can be acted upon, and such permission could not be given by the man at the East box, since he had already accepted the Clacton train, and the necessary distance of half a mile between his home signal and that of the box from which the signal was received did not exist. The quotation from the blocking-back regulations shows that that signal was inapplicable to the conditions existing, since the Gidea Park train was merely crossing from the local to the main line and was intending to continue its journey at once. The 400 yards rule is obviously intended to prevent the chance of over-running of signals in precisely the circumstances obtaining in the Ilford accident. The inspector summarises the evidence of the two signalmen in question, together with other evidence submitted, but makes no comment with regard to the apparent non-observance of the 400 yards rule quoted, or the effects that might have followed from carrying it out; nor does he remark upon the use of the blocking-back signal by the West box signalman when offered the Clacton train from the East box, or the apparent want of reason for the use of that signal.

Another point brought out by the report is that in advancing from the east towards Ilford Station a train passes first the Ilford East box up-distant signal, and afterwards the up-advance of the box in the rear, *i.e.*, of Ilford carriage-sidings signal-box. Similar arrangements might be found on other lines besides the Great Eastern, and there may be good reasons for them from the traffic-working point of view, but there are none from the point of view of signalling. A driver, when he has passed the distant signal for any section, has the right to consider that all stop signals he meets subsequently will refer to the section covered by the distant, and not to the section behind it. The signalman at Ilford carriage-sidings signal-box said that all his signals, including the advance in question, were off for the Clacton train; and the question arises whether this was not the signal which the driver "sighted" as the East box distant and "took it to be off: it was not in a doubtful position." It must not be forgotten that the Ilford East box up-distant was not "repeated" under the Ilford carriage-sidings box advance; that the only difference between the two arms would be the slot in the end of the distant arm; and that the two signals each occupied the other's position on the line under the usual conditions of erection. Nor must it be forgotten that drivers are acquainted with the rules guiding the signalmen, not, perhaps, to the full extent, but sufficiently to recognise the general conditions applicable to such a case as this, and sufficiently to lead the driver to infer from such knowledge that if all the signals were off for the Ilford carriage-sidings box, as was the case, the working of the 400 yards rule would ensure the line being clear to the Aldersbrook box west of Ilford West box. It is not sought by these remarks to minimise the driver's responsibility for the accident. It was undoubtedly his duty to observe and obey the signals, and his own evidence and that of others shows that in the words of the report "the morning on which the accident occurred was a clear one." Nevertheless, as the report shows on examination, there were other circumstances in connection with the occurrence which might well have been the subject of explanation.

The concluding paragraph of the report deserves special attention. Colonel von Donop draws attention to the desirability of providing "an unmistakable warning" as to the position of a distant when being passed: to the fact that several railway companies have made trials of devices for the purpose, and that on some lines such devices are in use to a limited extent; that the Great Eastern does not come into the category of the lines alluded to, although it has provided around London a large number of emergency detonator machines at its home signals; that it is at the distant signal that the warning is specially needed; and, finally, "in the face of this accident," the company's attention is called to "the desirability of this provision."

The paragraph seems to lack that directness of statement that one looks for in such reports. One is led to infer from the opening sentences that Col. von Donop refers to cab-signalling as providing something in the way of "an unmistakable warning," and probably it is so, but it is not so stated. The paragraph then refers to the detonator machines at the home signals; states that it is at the distant that the warning is especially needed, and calls the attention of the company to the desirability of *this* provision. Which? Cab-signals or detonators? It is possible to argue that only cab-signals giving both on and off indications can be meant, for the reason that detonators only indicate one position, and would not, therefore, meet the conditions, and give a warning showing the (actual) position when being passed, but it should not be necessary to have to revert to such reasoning.

Rubber. THERE has been a pretty steady tone in the market for crude rubber during the past few weeks, and price movements have been of but small importance though the tendency has been quite satisfactory from the point of view of producers, and this, notwithstanding the rather more subdued demand experienced from home trade manufacturers. There has been considerable apprehension entertained in connection with the difficulty of shipping material from Singapore, owing to the exceedingly limited freight facilities (which, by the way, look like being rendered more restricted still), and this may have a by no means unimportant bearing upon the position in a few months' time. Not only so, but there has been very slow progress made with the discharging of steamers arriving at London, and this has necessarily much hampered operations, whilst restricting the supply of parcels available for early delivery. There is no doubt that the demand which was experienced for parcels readily available, contributed substantially to the firmness of the market until towards the middle of the month, but latterly

labour conditions at the docks have been slightly improved, the working of the vessels proceeding rather more smoothly, and there seems now to be a more ready supply of spot and ready parcels available for the satisfaction of current needs. This, however, has not had much influence upon the tendency of the market generally. The clearances which have been made for the United States have been well below requirements, but it is hoped that the execution of outstanding orders will make more headway in future, and that at the same time United States demands will undergo an expansion within the next few weeks. Meantime the prospects as regards home consumption during the spring months are regarded as very encouraging, the demands for tires and other material of first-rate importance in the successful pursuit of the war on the Continent being such as to keep all working forces available employed at the utmost limit of productive capacity.

The efforts which have been made so consistently for two or three years in the direction of bringing down the cost of production of plantation rubber are now beginning to tell, and some of the reports of producing companies issued lately reveal the extent of the progress which has been made in this direction. It is significant, too, that these costs have been reduced, notwithstanding the very great difficulties which had to be faced in connection with the outbreak of war. The reduction in cost per lb. is rather startling in some cases. The Bikam concern, for instance, has dropped its all-in cost 5d. a lb. Selaba is 4½d. to the good, Golden Hope 3¼d., and Pataling 2¾d. a lb. on the right side compared with 1913, the cost of the last-named company being now actually below 10d. per lb., and these costs also include war risk insurance. The improvement does not arise entirely, moreover, from increased production, but is largely due to more efficient management of estates and the determined adoption of more economic conditions.

According to official figures issued, the exports of plantation rubber from the Straits Settlements during February amounted to 2,741 tons, as compared with 2,576 tons in January, and 1,703 tons in the corresponding month last year. The following table gives the comparison month by month for three years :—

	1913.	1914.	1915.
January	784	1,181	2,576 tons
February	743	1,703	2,741 „
Total ...	1,527	2,884	5,317 „

These figures include transhipments of rubber from various places in the neighbourhood of the Straits Settlements, such as Borneo, Java, Sumatra, and the non-Federated Malay States, as well as rubber exported actually from the colony, but they do not include rubber exports from the Federated Malay States.

Artistic Lighting Fixtures.

It cannot be denied that in this industrial age the artistic development of lighting fixtures has frequently fallen far behind their development in efficiency, but even in industrial concerns where economy is rightly given first consideration, it is becoming realised that colour and effect may compensate for some difference in actual cost. Industrially, this applies chiefly to the light itself, but in domestic and public interiors, and in exterior lighting, fixtures play, or should play, an important part in the decorative scheme. There is an artistic as well as a practical aspect of artificial lighting, and now that such efficient luminous sources are available, we can afford to pay attention to effect as well as efficiency.

Antique and mediæval lighting fittings were evolved to utilise the crude lighting agencies then available. Though at first as crude as the sources themselves, these fittings were gradually brought to a very high art level, and with the universal adoption of electric lighting, which can be adapted easily and safely to any form of fitting, there is a pronounced tendency to revert to Renaissance styles, Flemish models, and the styles of the seventeenth and eighteenth century French periods. Is it wise to follow these traditional styles, or ought we to create new and distinctive styles? In a paper before the Illuminating Engineering Society, Mr. F. W. Thorpe showed recently the very pronounced effect of even the earliest lighting devices on modern fixture design, and maintained that in interiors where it is sought to reproduce the atmosphere and spirit of the past, lighting fixtures should be as true to style as the other details of furniture. The inherent characteristics of electric lighting make this possible without risk and without incongruity.

On the other hand, the fittings of the past, particularly candelabra with their wide-spread, low-reaching arms, were evolved to suit dim and feeble sources of light, and attempts to reproduce them for artistic reasons are not facilitated by the relatively high domestic supply pressures and high-efficiency lamps now employed. Art is certainly not a product of modern civilisation, and there is no reason to suppose that in these days it can be carried to a higher level than was attained by the craftsmen of the past. Reproductions of their work, adapted with rigorous conservatism to modern requirements, often make up by their importance in the decorative scheme of an interior for what they lack in efficiency. The latter deficiency can frequently be made good by inconspicuous high-efficiency lighting to which the artistic fittings are supplementary as regards lighting, but predominant in æsthetic effect.

For modern interiors, however, where rigid purity of style is not required, advantage can be taken of the charm of contrast, and there is, no doubt, room for distinctive twentieth-century styles, if these can be evolved as a reasonable compromise between beauty and efficiency. Many modern fittings—particularly those of foreign origin—bear painful witness to the influence of cheap production on art. At the other extreme—in the production of art fixtures more or less regardless of cost—fittings manufacturers complain that unless they follow rigidly one or other of the fashionable traditional styles in vogue among architects, they can find no market for their products. Co-operation between architect, fittings manufacturer, and illuminating engineer is desirable and practicable. There is no reason why one of these should dictate to, or restrict the initiative or spoil the work of, either of the others. A flagrant example of neglected opportunity is to be found in almost every new building erected for commercial purposes or as a place of entertainment. It is known from the first that electric signs will be erected, but no place is left for them in the architect's scheme. As a result, the sign loses in its own beauty and effect, and only too often constitutes an eyesore by day.

In interiors there is room for individuality in the selection of fixtures, and the owner alone is credited with good or bad taste. Public lighting is, however, credited—or more usually debited—to national taste, though it is rarely representative thereof, even in the case of buildings erected by public authorities. There seems to be a tendency to think about lighting at the last moment, when either opportunity or funds available do not permit the provision of illumination worthy of and harmonising with the architectural scheme. As many public buildings are used more by artificial light than by day, this policy is the more inexplicable.

The lighting of streets should, at any rate in times of peace, be first of all efficient. At the same time, there is no reason why the considerable annual expenditure on new lamp-posts should not produce rather more acceptable standards than are generally to be found in our streets. Except in special cases, very ornate and costly designs would be out of place, and it does not seem generally necessary to make special arrangements for the lamp-post to be seen in all its details by night—with many existing designs, darkness is certainly merciful. True art may be quite simple; indeed, many of the lamp-posts now in use would be far more artistic, as well as cheaper, were their "decorations" omitted. Without emulating the extraordinary and often hideous fixtures which provide "display" lighting in the White Ways of the States, there is no reason why we should not use, at the same or less cost than at present, street standards which are effective by night, and, at least, not offensive excrescences by day.

C

ELECTRIC TOWING SYSTEM FOR THE PANAMA CANAL LOCKS.

The towing system described below was designed and patented by Mr. Edward Schildhauer, electrical and mechanical engineer of the Isthmian Canal Commission; and the 40 towing locomotives and all the electrical apparatus for operating the locks were built by the General Electric Co., of Schenectady, U.S.A. Some particulars of the system have already appeared in our pages.

In passing through the Canal from the Atlantic to the Pacific, a vessel will enter the approach channel in Limon Bay, which extends to Gatun, a distance of about 7 miles. At Gatun it will enter a series of three locks in flight and be raised 85 ft. to the level of Gatun Lake. It may then steam at full speed through the channel in this lake, for a distance of 24 miles, to Bas Obispo, where it will enter the Culebra Cut. It will pass through this cut, which has a length of 9 miles, and reach Pedro Miguel, where it will enter a lock and be lowered 30 ft. Then it will pass through Miraflores Lake for a distance of 1½ miles until it reaches Miraflores, where it will be lowered 55 ft. through two locks to the sea level, after which it passes out into the Pacific through an 8½-mile channel.

The main features of all the lock sites are identical, and

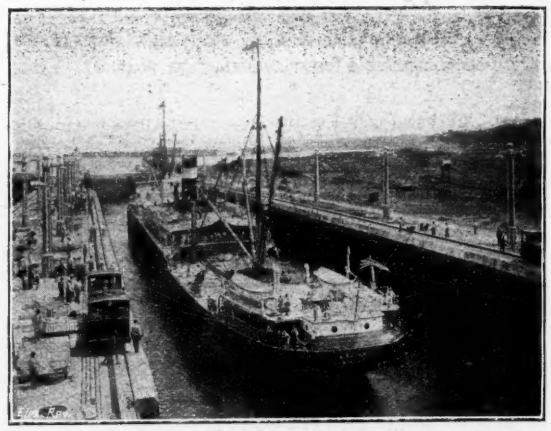

Fig. 2.—S.S. "Ancon" entering Upper Lock, towed by Electric Locomotives.

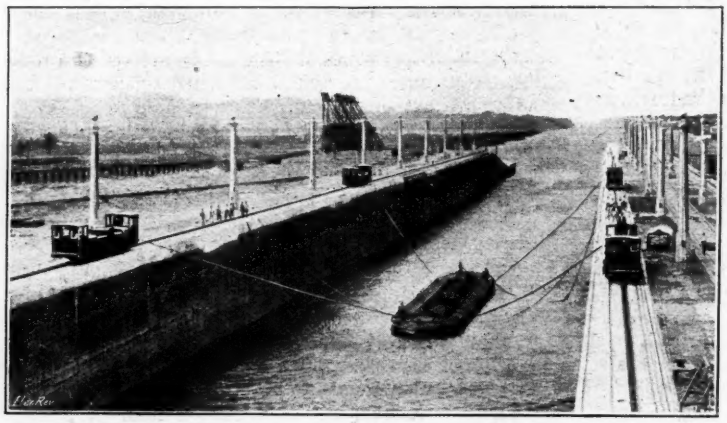

Fig. 1.—Towing Locomotives' First Trial Run with Barge through Gatun Locks.

the Gatun Locks may be taken as a typical example. There are two ship channels, one for traffic in each direction, separated by a centre wall, the total length of which is 6,330 ft. There are two systems of tracks, one for towing and the other for the locomotive returning idle. The towing tracks are placed next to the channel, and the system of towing utilises normally not fewer than four locomotives running along the lock walls. Two of them are opposite each other in advance of the vessel, and two run opposite each other following the vessel, as seen in fig. 1. The number of locomotives is, however, increased when the tonnage of the ship demands it.

Cables extend from the forward locomotives and connect with the port and starboard sides respectively of the vessel near the bow, and other cables connect the rear locomotives with the port and starboard quarters of the vessel. The lengths of the various cables are adjusted by special winding drums on the locomotives to place the vessel substantially in mid-channel. When the leading locomotives are started, towing the vessel, the trailing locomotives follow and keep all the cables taut. By changing the lengths of the rear cables, the vessel can be guided; and to stop the vessel, all the locomotives are slowed down and stopped, thus bringing the rear locomotives into action to retard the ship. In this way the vessel is always under complete control quite independently of its own power, and the danger of injury to the lock walls and gates is very greatly lessened.

Fig. 1 shows how effectively the four locomotives keep the vessel under control and in the centre of the channel, while figs. 2 and 4 give a general idea of the method of handling vessels of various sizes. They also show general views of the lock walls, towing tracks

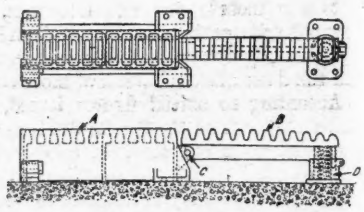

Fig. 3.—Approach Section of Rack Rail.

and the inclines, the steepness of the latter being especially noticeable.

The towing tracks have a specially designed rack rail extending the entire length of the track and located centrally with respect to the running rails. It is through this that the locomotive exerts the traction necessary for propelling large ships and climbing the steep inclines.

A rack rail (A, fig. 3) is also provided on short portions of the return track so as to lower the locomotives safely from one level to the next. The steepest slope is 26°, or 44 per cent., hence the need will be seen for rack rail even on the return track, it being noted that any traction

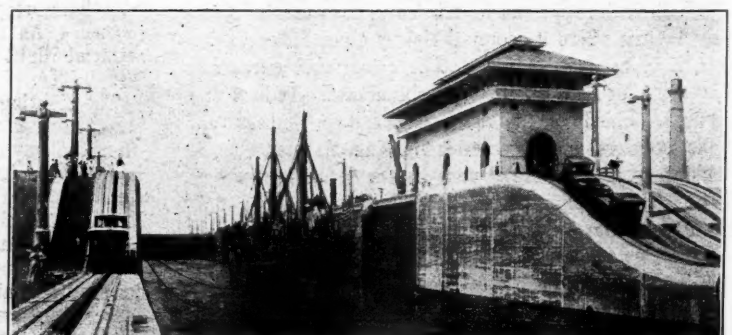

Fig. 4.—U.S. Tender "Severn" and five Submarines passing through Gatun Locks.

locomotive with the usual wheel drive, even with the brakes set, would begin to slide on a 16 per cent. grade, and therefore could not be controlled.

A small portion, B, at the end of the rack rail is hinged at

c, so that it can be depressed on the approach of the rack pinion of the locomotive; the teeth of this approach section are under size and shaped off at the extreme end, so that the teeth of the pinion will mesh properly and prevent excessive strain on the pinion and the axle. A spring, D, restores the approach to the proper position after the locomotive has passed over. The rack rail is of the shrouded type, and each tooth space has a drain hole cast in the bottom.

The rack rail also has projecting edges, which permit thrust wheels attached to the locomotive to run along the under side and prevent overturning of the locomotive, in case some unforeseen operating condition should produce an excessive pull on the towline. These thrust wheels serve to counteract the lateral component of the towline pull, and the flanges act for emergency only, as the weight of the locomotive is sufficient to prevent overturning with a normal pull of 25,000 lb. on the towline.

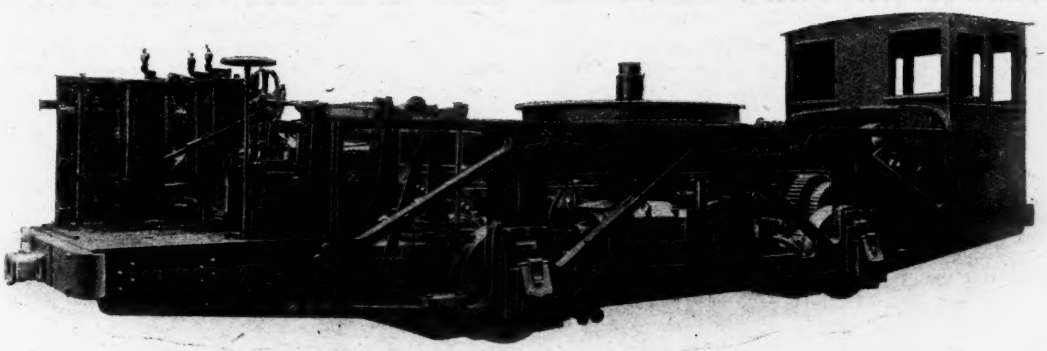

Fig. 5.—Electric Locomotive, with Covers and one Cab removed, showing Controllers, &c.

Three-phase, 25-cycle, 220-volt alternating current is used for operating the locomotives, and the current is supplied to them through an underground conduit adjacent to the running rail on the side remote from the lock; two T-rails form two legs of the three-phase circuit, and the third leg is formed by the main track rails. A specially-designed contact plough slides between the two conductors and collects the current from the rails.

The working parts of the locomotive are supported by two longitudinal upright side frames of cast-steel, connected by transverse beams; these frames are in effect deep rigid trusses, having upper and lower members connected by posts and diagonal braces. The pedestals for the wheel axles

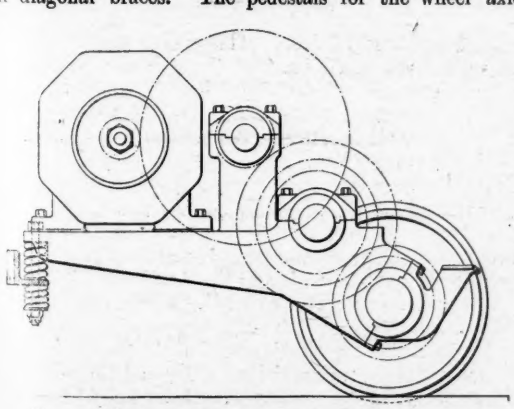

Fig. 6.—Arrangement of Motor, Gearing and Spring Suspension.

are of the usual locomotive type, having vertical parallel jaws between which the journal slides. Springs are interposed between the tops of the journal boxes and the tops of the pedestals, and the locomotive is thus mounted upon four wheels, the wheel-base being 12 ft., and the overall length of the locomotive over 32 ft.

Each axle is driven by its own motor, independently of the other. A cast-steel suspension bracket is hinged at one end on the axle (fig. 6). The bracket is provided with bearings for a transverse jack shaft, parallel to the axle; and it has pillow blocks for a countershaft, also parallel to the axle. It has a substantial horizontal platform to support the driving motor, and its outer end is supported at each corner by two springs, placed above and below a stationary angle iron, and connected to the bracket by a bolt, so as to afford a yielding support in both upward and downward movements of the bracket.

The motor is of the three-phase, enclosed slip-ring type, geared by a pinion and spur gear to the countershaft, which carries a pinion meshing with a spur gear, keyed to the jack shaft. On the outer side of the spur gear are formed clutch teeth, which co-operate with similar teeth on the adjacent side of a gear which is sleeved upon the jack shaft, and can be slid lengthwise thereon to engage and disengage the clutch teeth. A pinion keyed to the main axle is wide enough to mesh always with the gear, so that when the clutch teeth are engaged, the motor will propel the locomotive by the adhesion between the wheels and the rails of the track. The gearing is shown in fig. 7.

When the locomotive reaches one of the inclines between the locks, or when it is towing a ship, the cog rail system is utilised to enable the locomotive to climb the grade and exert the traction necessary. The cog or rack rail is laid between the track rails, and the locomotive is provided with a rack pinion secured to a sleeve which rotates freely on the axle.

A gear wheel secured to this sleeve meshes with a

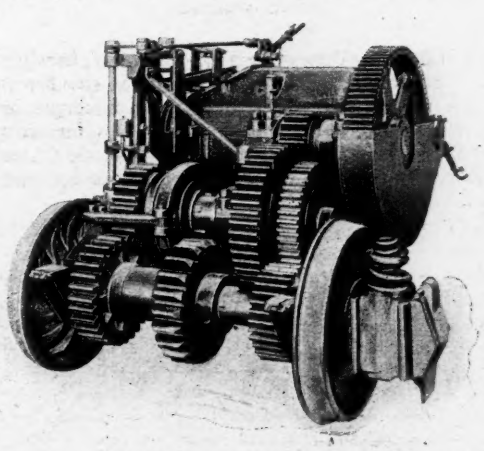

Fig. 7.—Front View of Traction Motor Unit, Clutches and Brake-Gear.

gear turning loosely on the jack shaft. Clutch teeth on this gear can be engaged by the teeth on a clutch which is splined to the jack shaft. A lever, pivoted to a collar riding in a groove in the clutch, is connected by a laminated flat steel spring with a handle in the cab of the locomotive, and is also pivoted to a rod which throws out the former clutch when the latter is thrown in, and *vice versâ*.

The jaw clutches in most cases do not mesh when thrown, but the operating handle is thrown full stroke and locked. This puts the springs under heavy tension. The locomotive is then started slowly, and when the clutches are

in alignment the springs throw them without any attention by the operator.

The two traction motors are controlled by suitable controllers installed in the cabs at the ends of the locomotives; the circuits are such that both motors can be controlled from either cab, and they can be operated singly or in parallel, as desired.

Each motor, with all its gearing and clutches, is mounted independently of the frame of the locomotive, to which it is connected only by springs, which give an elastic support for the outer end of the bracket, on which the mechanism is carried, as shown in fig. 6.

In connection with each motor a powerful brake is installed; and as during operation the motors are at all times geared either to the axles or to the cog wheels, the truck wheels are not provided with any brake rigging. On the motor shaft is keyed a brake drum, and to opposite sides thereof are applied the brake shoes, carried by levers pivoted on a stationary bar. The movable core of a solenoid is pivoted to the long arm of a lever, which, with the brake levers, constitutes a sort of toggle. When the core of the solenoid drops, it actuates the mechanism in such a manner as to apply the brake shoes to the drum. The winding of the solenoid is in circuit with the controller of the motors, so that when the current is turned on to energise the motor windings, the solenoid will lift its core and thereby release the brakes. The first point of the controller raises the brakes without applying power to the motors, thereby providing a coasting point. But should the motor current be shut off, either intentionally or accidentally, the

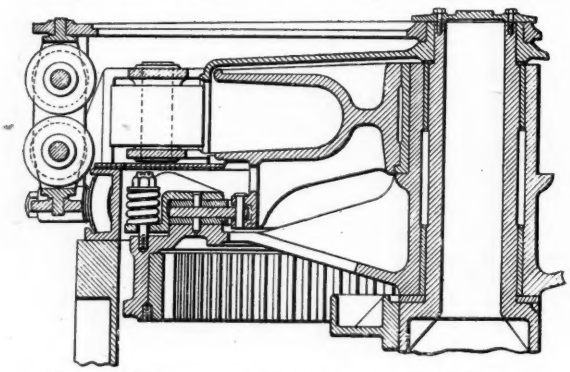

Fig. 8.—Part Section of Cable Guides, Drum and Friction Clutch.

core will instantly drop by gravity, and its weight will exert a powerful leverage upon the brake levers to stop the motor and the locomotive. In addition to this automatic brake, means are provided for applying the brakes manually, in order to supplement the action of the automatic feature, if necessary, when descending a grade or where approaching a rack rail.

The drum on which the cable is wound is located midway between the ends of the locomotive and above the upper member of the side frames, so that the cable can be led off on either side of the machine and through a wide range of angles to the line of travel. The hub of the drum is pivoted to the hub of a spider, which, in turn, rotates upon the upper portion of a massive tubular vertical column rising from a pedestal secured to the baseplate, which is supported on the lower members of the side frames. As shown in section in fig. 8, the spider supports a circular rim with a horizontal upper surface, to which is applied a powerful friction clutch connecting the spider and the drum.

Inside the flanged rim of the spider is secured a large internal gear, with which mesh two driving pinions, secured respectively to two upright shafts.

A wormgear is clutched to one of the shafts, and is driven by a worm on the shaft of an electric motor bolted to the base of the locomotive.

A bevel gear is keyed to the other shaft, and meshes with a bevel pinion on the shaft of an electric motor fastened to the base. The latter is used for driving the drum at a high speed when coiling the cable that has been cast off, and it remains permanently in gear. The other motor, with wormgear drive, is used for taking in the cable when it is under load, and the drum operates as a windlass or capstan. The wormgear drive is disconnected from the drum when not in use, by means of a clutch. The first point of the controller which operates the bevel-geared motor raises the clutch by means of a solenoid, and on the second point the motor starts.

The guide which directs the cable, as it pays out or winds up, is mounted so as to revolve on the axis of the drum. One portion of it is a circular bell which serves as a cover for the winding drum; the hub of the bell is journalled on the upper end of the column, being stepped on a shoulder thereon (fig. 8). At one side the housing is cut away to admit the cable to the drum, and on each side of this opening is bolted one end of a frame carrying two upright guide rolls, which have cylindrical faces.

The other guide member is a radial casting turning freely on the hub of the cover, and carrying at the outer end two grooved sheaves on horizontal axes. The edges of the e sheaves are in close contact, so that their grooves form an opening through which the cable passes, approximately in line with the middle of the guide rollers. The drum is in the form of a deeply grooved wheel, the groove being U-shaped.

The cable guard or cover is a steel casting having a thickness of only $\frac{3}{8}$ in.; the diameter is 4 ft. 6 in. and the

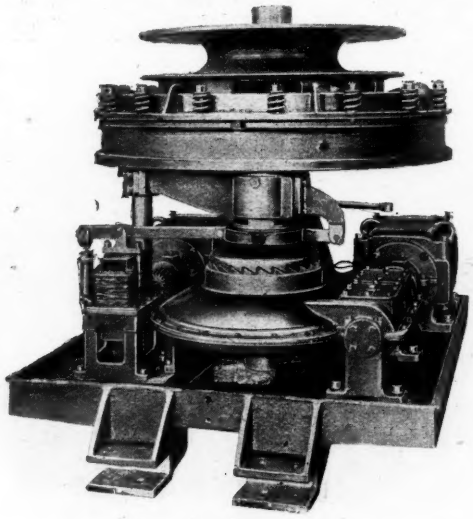

Fig. 9.—Windlass and Base Assembled Complete, with Motors.

circular flange is 17 in. deep. This casting was pronounced to be beyond the possibilities of the ordinary open-hearth furnace by a number of steel foundries. The castings were eventually produced in the contractor's electric furnace, where it is possible to intensify the heat so as to make the metal flow more rapidly.

One of the most important parts of the locomotive is the "slip-friction" device, consisting of two special bronze rings mounted on the spider, as has been previously mentioned. Between these rings a steel disk is fastened to the rope drum; the amount of tension on the towline is adjusted by the pressure between these three disks, which is obtained by tightening spiral springs on the clamping ring (figs. 8 and 9). In order to make the slipping tension of the towline proportional to the pressure between the friction disks, a rubbing surface having a constant coefficient of friction was essential. In order to find such a metal, experiments were made, and it was found that a certain alloy possessed the required properties with a friction coefficient of 0·1. This metal also showed but very little difference in coefficient between starting and running. The results of the special tests were amply verified by the final test of the friction disks of each machine under the full rated towline pull of 25,000 lb. by means of a dynamometer testing outfit; all 40 machines were given this slip test 25 times from each cab, and all passed the Government requirement not to exceed a variation of 5 per cent. above or below the normal of 25,000 lb.

The winding motor is a 20-h.p. (one-hour rating), three-

phase, squirrel-cage induction motor, and has ample power to take care of any sudden pull on the towline up to 40,000 lb., which is well above the normal requirement. The speed of winding is at the average rate of 12 ft. per minute.

The rapid-coiling motor is permanently geared to the drum, and is of the same type, size and capacity as the winding motor. It is subjected to its maximum load when accelerating the heavy drum to the high speed required for coiling or paying out the rope, this being 16 times the slow winding speed at full load, or about 200 ft. per minute.

The slow-winding and the rapid-coiling motors are operated by similar controllers, and the circuits are electrically interlocked so as to prevent the application of power to either motor unless the controller of the other motor is in the "off" position.

Each of the two main traction motors has a rating of 75 H.P., and is of the slip-ring induction type, operated by a system of contactors with master controller in each cab. The motors, by means of the change in gearing from straight traction to rack-rail towing previously described, drive the locomotive at a speed of 2 miles per hour when towing and 5 miles per hour when returning idle. These motors act as induction generators running above synchronous speed when the locomotive is passing down the steep inclines, and thereby exert a retarding brake effect to keep the speed uniform.

The locomotives, which weigh 38½ tons each, have fully demonstrated in actual operation that the requirements contemplated by the engineers of the Isthmian Canal Commission have been successfully met.

We are indebted for the foregoing particulars and illustrations to the General Electric Co., U.S.A., through the British Thomson-Houston Co., Ltd., Rugby.

BATTERY-CHARGING FOR ELECTRIC VEHICLES.

By FRANK BROADBENT.

The increasing popularity of the electric vehicle again raises the important question of battery charging. The method of charging a petrol car—viz, the pouring of a quantity of petrol into a tank—is simplicity itself, compared with the charging of an electric vehicle, which, besides being a relatively complicated process, takes about as many hours as the petrol car takes minutes. The introduction of the Edison battery, and the claim made for it, that it can be charged at a rapid rate without detriment, has reopened the question of constant potential charging for lead batteries. Although it has been recognised for many years that when fully exhausted a lead battery may with safety be charged at rates far in excess of what are called the normal rates, the common practice has been to charge at a practically constant current with a rising voltage until the battery gases freely. By this method a battery ordinarily requires charging for seven or eight hours to raise it from a fully exhausted to a fully charged state.

In ordinary practice with stationary batteries, it is not usual to exhaust a battery entirely. Thus on an isolated installation, such as that of a country house, the attendant charges two or three times a week, depending upon the season. He adjusts his voltage for the normal charging rate, and charges until the battery gases freely, the dynamo volts rising automatically as the current tends to decrease, due to the back E.M.F. of the cells. Gassing is not only detrimental, but wasteful, as the current consumed in converting the electrolyte into gas serves no useful storage purpose.

So long as a good modern battery on charge is not gassing or heating, it is usefully absorbing the current, so that if, when exhausted, the charging current is adjusted to a value just below the gassing point, it should take no harm. Under these conditions, it will be found that the initial current may be as much as three to five times what is commonly reckoned as the normal current, the permissible excess depending upon the make of battery. Generally speaking, if the applied voltage be approximately (but not exceeding) 2·3 volts per cell, the battery will take the current it can safely absorb, and as its back E.M.F. rises the current will automatically fall off.

For country-house work or other isolated battery installations, the constant-potential method of charging would necessitate a considerably larger generating plant than is ordinarily supplied. For instance, if we have a 54-cell battery whose normal charging rate is 50 amperes, the dynamo would be rated to give, say, 50 amperes at 100 to 140 volts or 7 KW., whereas if arranged for the constant-potential method, the output would need to be about 150 amperes, with a voltage not exceeding 125, or over 18 KW. Although the dynamo might be calculated on the basis of a 1-hour rating, and would therefore not be as large and expensive as the output suggests, the engine cannot be treated in the same way. The generating plant, therefore, unless used for other purposes than charging, would be much more costly. Where charging is done from public supply mains through a motor-generator, both the motor and generator armatures might be rated on the 1-hour basis at the maximum current.

This question of plant capacity has, no doubt, perpetuated the approximately constant current method of charging for isolated installations, and as in many cases a quick rate of charge offers little or no advantage, this method is, all things considered, probably the most suitable. Moreover, we have to bear in mind that in fully charging a battery on the constant-potential method we do not save much time, because the rate of charge tapers down nearly to the vanishing point after a few hours. Its great advantages are that we can put back such a large proportion of the discharge during the first hour, and that if left on for the full time we can obtain a greater ampere-hour capacity than by the constant-current method; and that it is better for the battery. There appears to be no reason, however, why in ordinary installations we should not start with a current very much in excess of the normal, and then, if we have voltage enough, we can keep the current up to the normal when it falls to this level. In this way the charging time can be materially shortened.

But the chief advantage of the high initial charge which the modern battery will stand is in connection with the electric vehicle. A brochure issued by the Chloride Electrical Storage Co., on "Boosting Charges for 'Exide' Vehicle Batteries," states the case very clearly. It is shown that when a battery is fully discharged a 30-minutes' boost at a pressure of 2·3 volts per cell gives us back 30 per cent. of the original capacity, and a 1-hour's charge puts back 50 per cent. This means that if we have a battery vehicle which will run for 40 miles on one complete charge, an hour's boost at the end of the run will carry us another 20 miles, that is, 60 miles in all. If, say, only 75 per cent. of the battery capacity has been used, corresponding to a run of 30 miles, an hour's boost will put back 42 per cent. of the original capacity, which, added to the unused 25 per cent., gives us a capacity equivalent to an additional 27 miles, or a total run of 57 miles. The advantages of this method, more particularly for commercial vehicles, which can return to headquarters at mid-day for an hour's boost, are very great. It means that a vehicle rated at 40 miles per complete charge can do 30 miles in the morning, and after an hour's mid-day boost is good for almost the same distance in the afternoon. A full charge would then be given during the night. Hence a 40-mile-a-day vehicle is converted into one having a range of almost 60 miles by taking a mid-day "pick-me-up."

Some useful experience has been recently gained in Hollywood garage in Chicago, equipped on the constant-potential system. It is found that if a battery is only 75 per cent. discharged, it can be recharged up to 85 per cent. of its rated capacity in two hours, and up to 90 per cent. in three hours. It is not stated how long it takes to charge up to 100 per cent., but obviously the last 10 per cent. will take longer than two hours as the current is continually diminishing. As the average duration of charge is given as 3½ hours, either the batteries are not discharged 75 per cent. on the average, or the charging rate is accelerated towards the end.

According to the description in the *Electrical Review and Western Electrician*, the method is not absolutely

a constant-potential method, as the initial current is limited to 60 amperes by means of a rheostat—apparently regardless of the size of the battery—the rheostat being gradually cut out during the first 10 minutes until the battery is directly across the line, after which the charge proceeds without further attention. It is not clear from the description what is the charging voltage per cell, but it may be assumed that after the first 10 minutes it is higher than would be desirable at first, and it is, no doubt, due to this that the charging period is found to be considerably less than on the old method.

This garage deals principally with passenger cars, of which many are run till midnight, so that they do not reach the garage till about 1 a.m.; and as they have to be delivered fully charged to the owners by 7.30 a.m., it is affirmed that the old method of charging would render this almost impossible.

Energy is taken from the Commonwealth Edison Co. under a restricted-hour contract, no charging being permitted until 9 p.m.; the rate is approximately 1·7d. per unit delivered to the A.C. converters.

All cars are garaged at a flat rate of $40 per month (say £8) for 40 to 42-cell cars, the cost covering charging, washing and polishing, adjustments, care of battery, and delivery to and from the garage. Smaller cars are garaged for $35 (say £7) per month.

The popularity of the commercial electric vehicle is growing so rapidly in England that there is a danger of its outstripping the growth of charging facilities. In a place like London, where electricity generating stations are so numerous, this might appear a somewhat remote possibility, but it is very doubtful if public generating stations are the best places for the purpose. Many of them are alternating-current stations, but, even so, they are not much worse adapted for charging purposes than those supplying direct current. In both cases, in order to do the business economically, motor-generators are necessary for obtaining the necessary charging voltage. True, it is possible to charge several batteries in series, but this is a very unsatisfactory method at the best, even if several batteries were available simultaneously; they would need careful watching to see that each received its proper charge, and that it was taken off at the right time and so on. It would, in fact, be such a nuisance that it would not pay any supply company to bother with the business on these lines. The constant-potential method, on the other hand, is simplicity itself. The battery is simply plugged in and the voltage does the rest. Nothing can go wrong, assuming the battery itself to be all right. But even under the best conditions battery charging is hardly the sort of thing for which a central generating station is laid out. To do it properly, a charging garage should be erected and treated as a separate department. It should be put on the same basis as a bulk consumer and allowed to make its own terms with customers so as to show a profit on the business done. The department would, it is true, be in competition with outside garages, taking current from the same station. But it would be a fairer form of competition than if no separate department existed and batteries were charged in a haphazard sort of way (under the supervision of someone who had really no time to give to it) at rates sufficient only to cover generating costs. Under the charging-garage system it is quite possible that an outside garage would be able to compete in price with a generating-station garage, because the rates paid to the station would depend upon the amount of business done, and this might very easily be in favour of the independently run garage, which would be erected in a convenient locality, and would be run by people who would lay themselves out to attract customers and to make the business pay.

STRESSES IN CONVEX DISHED ENDS.

Serious accidents have occurred owing to the failure of the dished ends of steam drums, one some few years ago at a London electricity station having lamentable results. In *Power* the strength of these ends has been mathematically investigated by Mr. F. G. Gasche, of the Illinois Steel Co., who has noted the frequency with which failures have happened in the curve or bending of the flange, and to this special point attention is directed. Unfortunately, the author finds it necessary to say "for the sake of simplicity in the analysis it is necessary to assume a perfectly rigid cylindrical drum as a basis for establishing a numerical value for a certain reaction." These assumptions of things which do not exist always raise fears that the whole investigation is unreliable. However, the conclusion of three pages of very elaborate figures is that

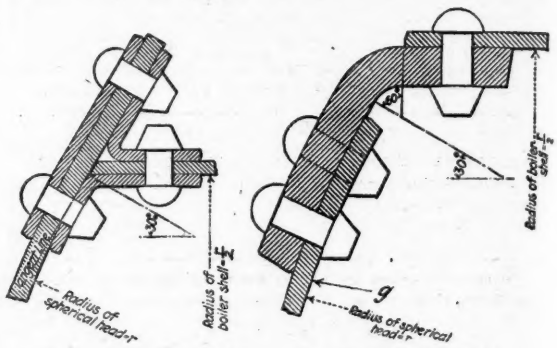

Fig. 1.—For Moderate Pressures.

Fig. 2.—For High Pressures.

Proposed Flange Connections for Large Drums with Convex Heads.

large spherical heads should not depend on large-radius flange fillets, but that the radius should be as small as possible even for moderate diameters of drum, and the two illustrations, figs. 1 and 2, show the connections suggested by the author to take the place of the simple flanged dish. Figs. 3 and 4 show the ordinary form of head, fig. 3 being the form condemned, and fig. 4 the form recommended with a very small radius between the curvature of the end and the flange. The dished end to a pressure vessel which has a radius greater than the radius of the cylindrical drum of which it forms the end is wrong in principle, for there must be a bending stress at the corner of the flange, and no amount of ingenuity of structural form can get over this. A head that is flatter than hemispherical will always be striving when under pressure to pull inwards the end of the drum to a smaller diameter, thus making of the drum end a frustum of a cone, though very slightly, of course. Still, the stress will be enough to cause grooving round the most strained locus if exposed to water in the slightest degree corrosive, and wherever grooving is set up under water it may be taken for granted that there is excessive fibre stress. The dished ends of steam drums and the flat ends of Lancashire boilers, with their gussets and, formerly, bar stays are all concessions to appearance, and to the difficulties of forming hemispheres of plate. The Lancashire boiler head is now also a shallow dished end, and is exposed to the undesirable stresses noted above. Formulæ proposed for calculating dished ends are given in the article referred to.

Comparisons between calculations for convex boiler heads based on various rules used in the U.S.A. are not very reassuring, for the allowable pressures found by three formulæ are in the ratio of 3, 2 and 1, the lowest value being that arrived at by the author, Mr. Gasche.

In boiler work there can be no really reliable formula for any part exposed to secondary stresses. There may be a life of such parts that will endure until the boiler is sold second-hand, to fail in its new position from a sufficient number of millions of stress applications. But for high-pressure work all dishing carries in it the elements of its own self-destruction.

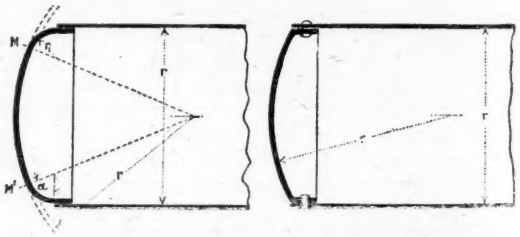

Fig. 3.—Ordinary Design.

Fig. 4.—Form preferred by Mr. Gasche.

Convex Dished Ends.

As regards fig. 3, it always has appeared to the writer of this note that this form was based on an attempt to make a dished end look as though its stresses were all primary. But one cannot juggle with stress forms. Fig. 4, the new suggested form, may be better than fig. 3, but there is more risk in pressing out these small corners.

Mr. Gasche is forced by his investigation to the forms, figs. 1 and 2, which do but tell us that the dished end is inherently bad. As to fig. 2, more particularly we suggest grooving stresses at g—B,

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

G.E.C. Explosion-proof Switchgear.

The latest development in the range of G.E.C. explosion-proof switchgear for fiery mines is a 20-ampere, 500-volt, double-pole explosion-proof switch with fuses. It consists of a standard double-pole "Twinbreak" switch actuated by an external handle working through an explosion-proof gland. The interlock between the switch and the lid gives the device all the usual G.E.C. mistake-proof characteristics. The fuses, which are of the standard bobbin type, are contained in a separate fire-proof compartment; arcing shields and thorough fire protection are provided throughout. If desired the switch can be had without the fuses.

The joint between the lid and case is made by well-machined flanges giving a close metal-to-metal joint; special attention has been paid to the part where the switch spindle enters the case,

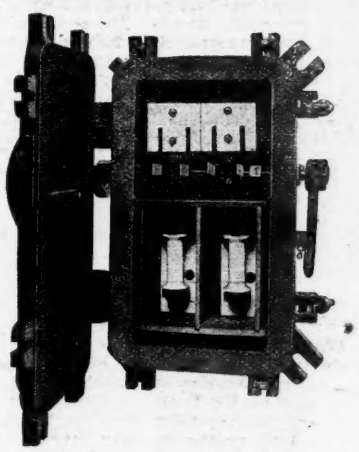

Fig. 1.—G.E.C. 20-Ampere Explosion-Proof Double-Pole Switch with Fuses.

and a special flame-proof gland is provided. The switch is designed to take the standard G.E.C. flame-proof cable glands, which also afford a ready method of attaching the armouring of the cable to complete the earth connection.

Further additions to the range of mining gear are explosion-proof fuses; these are contained in flame-proof cast-iron cases, which, as will be seen from the accompanying illustration, are of substantial design. As in the switches, particular attention

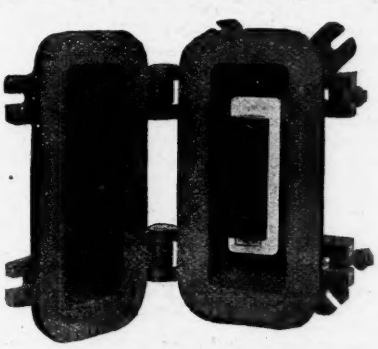

Fig. 2.—G.E.C. Explosion-Proof Mining Fuse.

has been paid to the flame-proof flanges, which effectively cool the products of any explosion inside the case. The fuse holders are of the G.E.C. Home Office bobbin type, and thoroughly protect the hand against dangers of shock, or from the effects of a blowing fuse. The cases are designed to take the standard G.E.C. flame-proof cable glands.

The switches and fuses are made by the General Electric Co., Ltd., of Witton, Birmingham.

Kasenoid.

Mr. A. W. Kanis, of 66, Aldersgate Street, E.C., has brought to our notice the material called "Kasenoid," which has been developed to fill the place hitherto occupied by Galalith; it can also be used instead of ebonite and xylonite for many purposes. We have inspected a number of samples of this very interesting substance, which is of purely British origin and manufacture, and strongly recommend our readers who use this kind of material to look into it. The properties of "Kasenoid" are quite similar to those of Galalith; it is tough, resilient, easy to machine, non-inflammable, a good insulator, capable of being moulded to a certain extent, and is made in a variety of colours, either as sheet (up to 8 mm.) or rod (up to 12 mm. in diameter).

It can be turned and polished, and takes an excellent thread. Large quantities are being made for use in non-electrical industries also, and we understand that it is meeting with a very favourable reception.

The Dictograph.

The General Acoustic and Dictograph Co., Ltd., of 7, Southwark Street, S.E., have recently introduced a modified pattern of their loud-speaking telephones for single lines, as illustrated in figs. 3 and 4. Simplicity of operation is one of the chief features of the system; the caller simply lifts the receiver, fig. 3, and talks to the box in an ordinary tone, while the voice is received, or delivered, in a loud and clear tone at the telephone shown in fig. 4; the person at the latter station replies in the same way, but without using a receiver or mouthpiece—neither being provided. If

Fig. 3.—Head Station.

Fig. 4.—Station Called.

desired, the instrument shown in fig. 4 can be fitted with a push-button to call No. 1. The complete Turner-Dictograph system provides for any number of stations connected with a master station, such as that shown in fig. 5; this is fitted with a loud-speaking receiver and a Turner transmitter, and the user can sit at his desk or walk about the room while he talks to his subordinates. The receiver shown is used when it is desired that the replies shall not be heard by any other person in the room; the act of lifting it from the hook

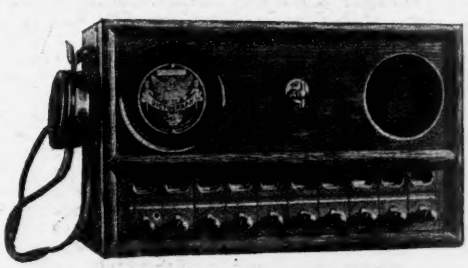

Fig. 5.—Master Station.

cuts out the loud-speaking receiver. Each department is provided with a Turner station like that shown in fig. 6, which, it will be seen, has not a loud-speaking receiver. To call any station, the user presses the corresponding key. When the master station is called, a buzzer sounds and a shutter drops; the master station depresses the corresponding key, and is then connected direct with the caller, no one else being able to cut in on the line. The master station can also converse with any number of departments at once by throwing the various keys.

Fig. 6.—Turner Telephone.

We have had an opportunity of testing the sensitiveness of the instruments, and can vouch for the ease and convenience with which one can both speak and hear at a distance of many feet from them, and without elevating the voice—indeed, a whisper can be heard plainly. The fatigue of holding a receiver to the ear is avoided, and for such purposes as dictating to a typist, for example, the system is admirably adapted.

LEGAL.

British Insulated & Helsby Cables, Ltd., v. Crittall Manufacturing Co.

Mr. Muir Mackenzie, one of the High Court Official Referees, on March 22nd gave judgment in this action, in which the plaintiffs sought to recover from the defendants the price of an electric welding machine for making steel casement frames, and material in connection therewith.

The Referee, in giving judgment, said that the case was one which presented features of considerable difficulty, and it had been the practice of the Appellate Courts to require that the Judge who tried the case should give his reasons for the decision at which he arrived, and he had therefore thought it right to put his conclusions into writing. The action was commenced in February, 1914, and was originally brought to recover £104 2s. 2d., which was made up of two items, as to one of which, £47 16s., the defendants admitted liability and paid that amount into Court. As to the balance in dispute, the defendants said that the goods were supplied in connection with tests of an electric welding machine which did not prove satisfactory, and that they were, therefore, entitled to refuse payment. The plaintiffs said that the goods supplied were kept by the defendants and used by them for the machine which was delivered, and that they therefore could not refuse to pay. The plaintiffs claimed a further sum of £444, the price of the welding machine, together with a copper coil to be used in testing. The defendants contended that the machine did not conform to the conditions to which by the contract it was to conform, and that they were therefore entitled to reject it. They counterclaimed for damages by reason of the failure. The first question to be decided was what was the contract between the parties. The defendants were makers of iron casement frames for windows, and before the negotiations with the plaintiffs they used gas for welding. They desired to adopt the more economical and more rapid process of welding by electricity. The two features of the plaintiffs' machine were, first, the generation of heat by electricity, and, secondly, the application of pressure to the ends of the bars where they were to be welded. Negotiations between the parties commenced in 1911, and continued during 1912, when the contract was made with the plaintiffs to supply a machine, and in the course of the negotiations specimens of the defendants' steel bars, which they wanted the machine to weld, were sent to the plaintiffs, so that they knew the work their machine would be required to do. The plaintiffs decided that they could make a machine as required, and an order was accordingly given to them. One speciality of the contract was that the machine should be capable of welding to an accuracy of $\frac{5}{1000}$ inch, that it should be able to produce 12 frames in an hour, and that it should be able to make frames of from 1 ft. to 10 ft. square. The order was given conditionally upon the work being submitted to the defendants for approval before the machine was put in hand. The work was to be of the best quality, and the electric conductors were to be of sufficient area to admit of continual working without undue heating. Part of the machine consisted of clamps made of copper which were to fit closely to the bars, and it was, therefore, necessary for the makers to have the proper dimensions of the bars. The defendants took steps for supplying the electricity for working the machine and for laying down the foundations for fixing it. The alternator was obtained and fixed by September 12th, 1912. Although the plaintiffs proceeded with the manufacture of the machine it was not ready within the time specified by the contract. In October the machine was ready, but the necessary clamps were not made, because the material had not been sent. The machine was sent by arrangement to the defendants' works at Braintree, and they arranged to re-design the clamps and test it. The test was made in the presence of representatives of the plaintiffs; but the results were not satisfactory, and the opinion was that the cause of failure was that with the clamps, as then made, their bars could not be properly welded. Subsequently the machine was tried again with unsatisfactory results, and the plaintiffs raised the point that the cause of the failure was the variation in the dimensions of the bars. The defendants, however, said that the welder was not fit for the work, and it was arranged that it should be sent back to plaintiffs to make alterations in order to overcome the difficulty occasioned by the variation in the dimensions of the bars. The plaintiffs declined to accept responsibility for the expense to which the defendants had been put, and difficulties arose in consequence, and when the plaintiffs began to press for the price of another electric welder, defendants objected to pay, on the ground that they had suffered a loss of between £400 and £500 by the failure to make the machine according to contract. Differences having become acute, a meeting of the representatives of both sides was arranged for June 11th, 1913, when a certain settlement was arrived at. It was part of the terms of that settlement that the machine was to be made so that it could be demonstrated, by test with material to be supplied by the defendants, that it was commercially valuable. By September, 1913, the plaintiffs having made alterations in the design of the clamps, they invited defendants to send representatives to see the machine at the plaintiffs' works; but it was found that the work was not good. Further tests were made afterwards, but it was not shown that the machine could weld the bars satisfactorily, and the defendants, therefore, refused to accept it. He found that the obligation of the plaintiffs under the settlement of June was to make the machine so that by test and demonstration it would reasonably satisfy the defendants that it was fit for their requirements. The plaintiffs failed to do that, and he therefore found that the defendants were not bound to accept the machine. As regards the claim for goods supplied (£56 16s.), they were delivered for trials of the machine; and as the machine failed, the defendants were not bound to keep the goods. That claim of the plaintiffs failed also. As to the counterclaim, the defendants alleged that plaintiffs failed to make and deliver the machine according to contract, and they claimed for the price of the alternator, the cost of the foundation for the alternator, the expenses connected with the work, the expenses of their representatives in attending the tests, and some other small incidental expenses. His opinion was that the plaintiffs were made sufficiently aware of the nature of the materials defendants used for their casement frames, and that the plaintiffs' contention that the contract was not broken because the material varied, was ill-founded. The defendants were entitled to reject the machine, because it was not in accordance with the contract. As to the machine not being up to the requirements, the plaintiffs said that it was put to work which it was not designed to do. Although the contention of the plaintiffs was erroneous, it was one which they were entitled to use. The arrangement which was come to disposed of the counterclaim for damages up to that date, and the claim of the defendants to recover such damages failed. Their claim for expenses in relation to the tests was very much exaggerated. He directed that judgment in the action should be entered for the defendants, with costs of the action, and that judgment on the counterclaim should be entered for the plaintiffs, with the costs of the counterclaim. As he had decided against both of the parties, he would stay proceedings under the judgment for ten days, and if both or either of the parties entered an appeal within that time the stay would continue until the appeal, which in the present state of the lists, would only be a short time.

Judgment was entered accordingly.

Extraction of Water from Peat by Electricity.

For several days last week the Court of Appeal, composed of the Master of the Rolls and Lord Justice Phillimore and Mr. Justice Joyce, was engaged in hearing an appeal by Witcarbonising, Ltd., from a judgment of Mr. Justice Warrington, in the Chancery Division, dismissing their petition for revocation of Letters Patent, No. 10,370 of 1911, granted to John Eustice Jameson, Oliver Harris Valpy and Edmund Arthur Buckle for improvements in the treatment of peat and the like. One of the claims was as follows:—"In the process of extraction of water from peat and like substances, passing an electric current through the pulp of the same heated to a temperature of at least 100° C., under a pressure such that no steam is produced, substantially as described."

The petitioners (the appellants) applied for revocation of the patent upon the ground that it was invalid for want of utility and insufficiency of directions. It was proved that the water in peat was partly free and partly combined in the form of "hydrocellulose," and that the combined water could not be got rid of by pressure as the free water could. Prior to the patent it had been suggested that the water could be removed by the use of a comparatively high temperature and pressure. The patentees (the respondents upon the appeal) alleged that the result could be attained by the use of an electric current at a lower temperature. The petitioners contended that the only result obtained by the use of the current was due to its heating effect.

Mr. Justice Warrington, in the Court below, held that the specification described a process in which the electric current was used to effect the decomposition of the "hydrocellulose" without recourse for that purpose to heat, while the earlier process depended on the effect of heat alone; that the process was useful; and that the directions were not insufficient. His Lordship accordingly dismissed the petition with costs, and granted the respondents a certificate of validity. Hence the present appeal of the petitioners.

Mr. Walter, K.C., Mr. Colefax, K.C., and Mr. Frost appeared in support of the appeal; and Mr. Bousfield, K.C., and Mr. J. Hunter Gray for the respondents.

The hearing was concluded on March 26th, when their Lordships reserved judgment.

Lighting Regulations.

At the Hull Police Court on March 23rd, Mr. Frank Garnett Jones, manager for Messrs. Ostler, was summoned for failing to comply with the Order of the General Officer Commanding the Humber Defences, in regard to the reduction of shop lighting.

It was stated by the police that the defendant had had lights in the shop which were so strong that they illuminated the whole street. There were 13 electric lights, and it was believed that half of these would have been all that were necessary under the present circumstances for the conduct of the business.

The Defendant said he had forgotten about the regulation, but Inspector Gall stated that he had spoken to the defendant on five previous occasions about the matter.

The Bench imposed a fine of £10, including costs, and ordered the defendant to pay £2 2s. solicitor's fee, with an alternative of two months' imprisonment.

London Tramway Assessment Appeal.

In the House of Lords, on March 26th, the Lord Chancellor and other Lords dealing with the matter gave their reasons for having recently allowed the appeal of the L.C.C. in their tramways litigation with the Borough of Islington. We shall refer to the matter later.

Marconi Agreement Dispute.

After a hearing extending over 15 days, Mr. Justice Avery and a special jury in the King's Bench Division, concluded the hearing of the action brought by Mr. John William Hamilton, civil engineer, and a former agent of the Marconi Co. in Australia, against the Marconi Wireless Telegraph Co., Ltd., claiming damages for alleged wrongful dismissal. He also claimed commission alleged to be due under an agreement under which he acted as the company's agent in Australia. The defendants pleaded that they were justified in their action and counterclaimed against the defendant in respect of alleged breach of duty.

Sir Edward Carson, K.C., M.P., and Mr. Eustace Hills were counsel for the plaintiff, and defendants were represented by Mr. Duke, K.C., M.P., and Mr. Stuart Bevan.

Sir Edward Carson, in opening the case, said that with regard to the commission certain sums were admitted, and on that part of the claim a question of construction arose which would be for his Lordship's decision. The jury would not be troubled with amounts as it had been agreed that that should be held over until the question of construction had been determined; the main claim for the jury would be for breach of agreement owing to the alleged wrongful dismissal under circumstances which, whether right or wrong, had brought about a loss of many years in the Colony in which the plaintiff was a man of influence and with long business connections. In 1910 it was agreed that the plaintiff should act as sales agent for the company in all the British Colonies situated within certain limits. The agreement was for three years, and would not terminate until May, 1913, but the company dismissed him in January, 1913. The plaintiff was to receive 5 per cent. of the gross value of sales in his territory, and if satisfactory the agreement was to continue for a further three years. In July, 1912, the plaintiff had an unfortunate dispute with Mr. Godfrey Isaacs. That was not put forward as a reason for determining the agreement, but from that time he was not allowed to do business for the company, and was refused all information as to what was going on. The reason given was that the Amalgamated Wireless Co. was to represent the defendant company in Australia.

A great mass of correspondence was read, and several witnesses were called on both sides, Mr. Godfrey Isaacs being amongst those who gave testimony for the company.

His Lordship concluded his adjourned summing-up on Wednesday, March 24th, and the jury, after an absence of four hours, returned to Court with a verdict for the plaintiff on all questions submitted to them.

Legal arguments on the questions of law raised in the case were adjourned until the following day.

On March 25th, after hearing arguments by counsel on the finding of the jury, Mr. Justice Avory entered judgment for the plaintiff. Judgment, he said, must be entered for the plaintiff for £300 and £2,340 which had been awarded by the jury, and also on the counterclaim. There would also be judgment for the plaintiff for the sums admitted to be due—namely, £35 15s. 4d. and £82 2s. 9d. Further, he would direct an account as to commission on a 5 per cent. basis, and judgment for the plaintiff for the amount found due. In ascertaining the commission, the prices must be taken to mean the contract price for the apparatus supplied for the installations carried out by the defendant company, where it was clear under the agreement he was himself to effect the contract for supplying the apparatus and installations.

Stay of execution was granted pending an appeal.

An Aberdeen Claim.

The record has been closed in the Sheriff Court in an action at the instance of a local watchmaker against James Pirrie, electrical engineer, 4, Hosefield Place, Aberdeen, for payment to the pursuer of damages laid at £700. The claim is in respect of bodily injuries caused to the pursuer through the alleged negligence of the defender, who, while driving a motor cycle and side-car along Cornhill Road, turned it on to the pavement and knocked down pursuer. Defender pleads that the accident was not due to any fault of his, but he has offered £140 in settlement of all claims against him by pursuer, which offer has been refused.

WAR ITEMS.

German Electrical Companies in War Time.—The Elektrotechnische Fabrik Rheydt (Max Schorch & Co.), of Rheydt, proposes to pay a dividend of 12 per cent. for 1914, as compared with 8 per cent. in the preceding year.

The gross profits of the Elektrochemische Werke, of Berlin and Bitterfeld, arising from the working community with the Griesheim-Elektron Chemical Works, and from manufacturing and investments, amounted to £86,000 in 1914, as compared with £84,000 in 1913. After defraying general expenses and providing for depreciation, the accounts show net profits of £62,000 as against £61,000 in the previous year, permitting of the payment of a dividend of 10 per cent. as in 1913. Under the company's agreement with the Griesheim-Elektron Works, which was concluded in 1889 for a period of 30 years, the former leased most of the works plant to the latter for the manufacture of chloride products and alkalies, carbide, sodium and magnesium.

The directors of the A.G. Mix und Genest, of Berlin, Telephone and Telegraph Works, state that the development of the works in 1914 was such that it was only possible to meet the requirements by a rapid accommodation of working methods to the new problems raised by the war. In addition to the usual business a considerable turnover was also effected by the execution of war orders, although the profits realised by the inland branches were less than in the preceding year in consequence of the war. On the other hand, the oversea business had been almost at a complete standstill since the outbreak of hostilities. It was proposed to liquidate the subsidiary company in Italy, but this would not result in any loss as compared with the balance sheet. The gross profits amounted to £107,000. After meeting general expenses and setting aside £18,000 for depreciation, the net profits are £60,000, as against £14,000, and a dividend of 12 per cent. is in contemplation, as contrasted with 4 per cent. in 1913.

The report of the Kabelwerk Duisburg, of Duisburg, characterises the past year as having yielded gratifying results, which are attributed, in addition to the great activity in the first half of 1914, to the favourable purchase of raw materials. After appropriating £23,000 for depreciation, as against £35,000 in 1913, the net profits are returned at £56,000, as compared with £46,000. The reduction in the amount set aside for depreciation is explained by the fact that a sum of £20,000 for special depreciation was allocated in 1913, thus bringing the book value of the machinery account down to one shilling. It is proposed to pay a dividend of 18 per cent. for 1914, as contrasted with 16 per cent. in the preceding year, and to place £12,500 to the guarantee fund for foreign debt risks and £12,500 to the contingency fund, leaving £1,800 to be carried forward. The report states that the extensions of the works were interrupted by the outbreak of war, but it is hoped to complete them by the end of June.

Power Transmission and the War.—How the activity of a company can be adversely affected by the prevalence of war when a portion of its area of supply is situated within one part of the war zone is strikingly illustrated by the experience of the well-known Rheinfelden Power Transmission Co., of Rheinfelden, down to the end of last year. During the first seven months of the year, the company's report states, a further development in the utilisation of the hydro-electric works at Rheinfelden and Wyhlen took place, the increase in consumption having almost entirely absorbed the output of the works. On the outbreak of war, however, the first effect on the works was the withdrawal of the German workmen; and secondly, the large bulk consumer represented by the Upper Rhenish Power Works Co., of Mulhausen, was compelled almost entirely to suspend the supply from August 8th, after the transmission lines and various installations in Alsace had been severely damaged by incidents of the war. In addition, the Wiesenthal railway, which receives electrical energy from the Wyhlen Works, was also compelled to stop the electrical service of trains. The result of these unfavourable developments was that the total delivery of energy, which amounted to a load of approximately 23,000 kw. at the end of January, 1914, receded to 4,000 kw. by the middle of August, which was almost uniformly divided between the Rheinfelden and Wyhlen works. It was, however, possible, in connection with the Upper Rhenish Power Co., to repair the transmission lines in Alsace in the first week of September, and the normal delivery of energy to Mulhausen was then resumed. The installations of most other consumers were also brought into operation gradually, so that the total load was increased to about 17,000 kw. in the last three months of 1914, but a reduced consumption prevailed down to the end of the year in the case of the Wiesenthal railway, an electro-chemical works, and the Zell Electricity Supply Co.

Lampmakers and the War.—We learn that the employés of the Osram and Robertson Lamp Works have collected by weekly subscriptions, up to March 24th, a total of £349 towards the Prince of Wales's War Relief Fund. The Lamp Works have 73 men who have joined H.M. Forces, and information has been received of four of the men being wounded. Fortunately, so far, no fatal case has been reported.

New Zealand.—An Auckland firm is prepared to take up agencies for United Kingdom manufacturers of cast-iron pipes and fittings, steel girders and channels, wrought-iron and overhead cables and electric wires, motor-car accessories and tires. A firm of electrical engineers and contractors in Invercargill desires to represent United Kingdom manufacturers of all classes of electrical machinery, appliances and fittings. The names may be ascertained at the Board of Trade Commercial Intelligence Branch, London, but communications should be sent to H.M. Trade Commissioner for New Zealand, P.O. Box 369, Wellington.

Australia.—Representation for a British firm of electric crane-makers is wanted by an agent in Melbourne, whose name may be ascertained at the Board of Trade Commercial Intelligence Branch in London. Communications to H.M. Trade Commissioner for Australia, Commerce House, Melbourne.

War Bonus Protest.—The Executive Committee of the Manchester Ratepayers' Association has organised a strong protest against any proposals to grant municipal employés a war bonus.

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Russia.—It is announced that a meeting of prominent British and Russian merchants was held in London (at 1, Charing Cross Road, S.W.) last week, at which it was resolved to form the "Russian Chamber of Commerce in London" for the purpose of facilitating the promotion and extension of trade between the two countries.

Italy.—The British Chamber of Commerce is forming a branch at Rome.

Board of Trade Assistance.—The Board of Trade Commercial Intelligence Branch has issued list No. 13 (for the week ending March 20th) giving particulars of further inquiries received for sources of supply of goods.

Roll of Honour.—The "City Press" states that Private W. W. Pullen, Engineers' Section of the Royal Naval Division, who died on March 12th at the R.N. Hospital, Malta, was assistant engineer at the Leatherhead Power Station. He was a student under Prof. S. P. Thompson, at Finsbury. In the early months of the war he responded to the circular issued by the President of the Institution of Electrical Engineers.

Private Jas. Henry Gardner, of the King's Own Rifles, formerly a motorman in the employ of the Blackburn Corporation Tramways Department, died last week at Manchester, after the amputation of a foot. He was 30 years of age, and was wounded in France. He was buried with military honours, and the funeral was attended by about forty tramwaymen.

Personal.—"London Gazette" announcement:—Territorial Force: Electric Lights Company, Renfrewshire (Fortress) Engineers; Cadet William MacNicol Adam, from Inns of Court Officers Training Corps, to be Second Lieutenant. March 27th.

The Ilford Urban Council has declined to grant leave of absence to Mr. A. Glazier, engineer-in-charge for the Electricity Works, who has been offered a post as electrician in the Mechanical Transport Service Corps for the duration of the war, as the staff is already short-handed, 20 having joined the forces.

Mr. Thos. Cooke, electrician, Cambridge, and Mr. John Herbert Merry, electrician, Cherryton, have joined Kitchener's second army, being recruited at Cambridge.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Power and Lighting Rates.

I think it will certainly interest many of your readers to have the following information on the subject of electricity charges for photo-printing purposes, and I agree to your making what use you desire of such information.

The Ilkeston Town Council at its last meeting, held on March 2nd, passed the following resolution:—

"Resolved that the Town Clerk be, and he is hereby, instructed to prepare a case for the opinion of counsel as to the power of the Corporation to supply electricity to photographers for photo-printing purposes at power rates; and that such case be submitted to Mr. W. E. Tyldesley Jones, the editor of 'Will on Electric Lighting, Power and Traction,' for his opinion."

Mr. W. E. Tyldesley Jones's opinion is not yet to hand, but the circumstances relating to the position at Ilkeston have also been laid before the Local Government Board.

I might explain that I was Chairman of the Ilkeston Corporation Electricity Committee, and the following five questions of mine were put to the Board:—

1. "Is it illegal to supply current for photo-printing at power rates?"
2. "If we supply at power rates are we liable to be surcharged?"
3. "Can you quote any test cases bearing on the point?"
4. "Can you give me the names of a few towns where they have L.G.B. auditors?"
5. "Can you tell me where I can get a complete list of the towns who have L.G.B. auditors?"

The last paragraph of the letter to the Board was a request that instructions be given to the auditors that no surcharge be made in cases where power rates were being charged for photo-printing purposes.

The following is a copy of the Local Government Board's reply:—

[Copy.]

LOCAL GOVERNMENT BOARD,
WHITEHALL, S.W.

Sir,

Photo Printing and Auditors, etc.

I am directed by the Local Government Board to advert to your letter respecting the cost of electrical energy supplied for the purpose of photographic printing.

In reply to the questions numbered 4 and 5 in your letter, I am directed to forward to you the accompanying list of councils of municipal boroughs whose accounts are audited by district auditors, and to state that the accounts of all urban district and rural district councils also are subject to such audit.

In reply to the questions numbered 1 and 2, I am to state that these matters seem to depend upon the terms of the special Act or Provisional Order under which the supply is given. The Board are not aware of any provision in the general law upon the subject.

In further reply to these questions and to question 3, I am to state that the Board are not aware of any decision of the Courts upon the point, and that they do not find that it has arisen on an appeal made to them from a decision of a district auditor. Apart from such an appeal they would have no power to decide the point.

The Board are not empowered to give any such instructions as are suggested in the last paragraph of your letter.

I am, Sir,
Your obedient servant,
(Signed) D. DOLTON,
Assistant Secretary.

I think the above sentence which reads "The Board are not aware of any provision in the general law upon the subject" is very significant.

(Coun.) William Smith.

Ilkeston, *March 27th*, 1915.

BUSINESS NOTES.

Bankruptcy Proceedings.—GEORGE DRIVER & SON, electrical and mechanical engineers, Hythe Road, Willesden Junction.—The first meeting of creditors was held on March 23rd at the London Bankruptcy Court. Mr. E. Leadam Hough, Senior Official Receiver, reported that the business was commenced in 1891 by Mr. G. H. Driver at Euston Buildings, Euston Road, and two years later that gentleman was joined in partnership by Mr. E. W. Fladgate. In 1895 the present debtor, James Proctor Kyd Clark, became a partner, and put in £500 for a third share of the business, which was removed to Hythe Road in 1899. Mr. Fladgate retired during the ensuing year, under terms that he was to receive 5 per cent. per annum on his capital of £1,500 which he left in the business. It was further arranged that he was to receive that interest during his life, with succession to his sister. The business was continued by the debtor and Mr. Driver under the old style as equal partners until 1903, when the latter died, and the debtor arranged to pay out his late partner's capital of £1,600 to his executors by instalments. He subsequently continued the business alone, and at that time arranged to pay Mr. Fladgate £750 of his capital by instalments, and of that he had paid £250. The business was solvent at that time, and was continued by the debtor till last September, when he agreed to sell the goodwill and all the properties connected with the business for £200 to a Mr. W. J. Thomas, who also agreed to take over the trade debts and the liability to Mr. Fladgate. He obtained the £200 in October, and had used the money for living expenses. In 1901 the debtor and Mr. Driver formed the Driver Automatic Weighers, Ltd., to take over from the firm the goodwill of a patent weighing machine business. The capital of the company was £10,000, in 5,000 preference and 5,000 ordinary shares of £1 each. In 1905, in consequence of competition, it was decided to realise the bulk of the assets of the company, and from the proceeds of sale the claims of the creditors and preference shareholders were discharged. No statement of affairs had been lodged, but the debtor roughly estimated his liabilities at £1,850, of which £1,700 was due to the petitioning creditor in respect of a disputed claim, and he had no assets of any kind. It was a question, added the chairman, whether the debtor intended by the sale of his business to Mr. Thomas to defeat the claim of the petitioning creditor. In the absence of any offer the case was left in the hands of the Official Receiver, to be wound up in the ordinary course of bankruptcy.

Catalogues and Lists.—MESSRS. J. H. HOLMES & CO., Newcastle-on-Tyne.—Illustrated and priced leaflet (No. 60) describing their liquid starting switches for polyphase slip-ring motors.

MESSRS. GILLESPIE & BEALES, Norfolk Street, Strand, London.—Illustrated descriptive list relating to the "Nilfisk" electric suction cleaner; also a leaflet giving special points for the trade concerning it.

THE COUNTY OF LONDON ELECTRIC SUPPLY CO., LTD., has issued a wall telephone card for the use of its consumers.

MESSRS. ARNOLD, GOODWIN & SON, LTD., Sumner Street, Southwark, London.—List No. 160 containing tabulated particulars and illustrations of the firm's belt-driven air compressors.

MESSRS. ERCOLE, MARELLI & CO., of Milan.—Eight-page illustrated list describing in Italian their small electric motors, transformers, pumps, electric fans, &c.

THE "LOWA" ELECTRICAL CO., 86-90, Chancery Lane, London, W.C.—Circulars giving particulars of the "Lowa" dimming switch and the "Grip" shade carrier.

Book Notice.—"Motor Cycles." By B. E. Jones. London: Cassell & Co. Price 1s. net.

Private Arrangements. — The British Prometheus Co., Ltd., Salop Street, Highgate, Birmingham, Warwick. —In pursuance of Sec. 188 of the Companies' (Consolidation) Act, 1908, a meeting of the creditors interested herein was held on March 25th at the offices of Messrs. Poppleton & Appleby, chartered accountants, 26, Corporation Street, Birmingham, when an approximate statement of affairs was presented showing the position as at January 23rd last. According to this the liabilities totalled £1,590, of which £1,490 was due to the trade, the balance being in respect of a liability under lease as to repairs. The assets were estimated to produce £9,164, and comprised stock in trade £3,832; patent rights, £300; book debts, £1,700; plant and machinery, £1,286; tools and patterns, £211; office furniture, £250; and cash in bank, £1,585. After allowing £6,913 for the claims of the preferential creditors and debentures, the net assets were reduced to £2,221, the estate showing an apparent surplus of £631. It was stated that the company had been adversely affected by the war. The accumulated losses between 1902 and 1914 had amounted to £5,700, while £9,200 had been written off the assets. The loss from July 14th last to date was £1,800. The matter was left in the hands of Mr. C. T. Appleby, as liquidator, with a committee consisting of Messrs. E. Pugh & Co., Mr. Robert Rigby and Mr. Cripwell representing creditors.

Sydney Contracts.—The Sydney Municipal Council has adopted the following motion, viz., "That in view of slight informalities in tenders having caused lowest tenders to be rejected, entailing loss to the citizens, it is desirable that a clause in conditions of tendering be inserted to admit of such informalities being waived and the tender being considered, provided the Council is satisfied that such informality is *bonâ fide* and not prejudicial to the true interest and meaning of the specification and conditions as to tendering."—*Tenders.*

Composition.—G. Braulik, 8, Lambeth Hill, E.C.—Mr. G. E. Corfield, the trustee, reports that the business under his supervision has been continued upon a satisfactory basis. He has now declared the fourth and final instalment of 2s. 6d. in the £, making 10s. in all. In regard to new goods which have been or may be ordered in future, Mr. Braulik will take all responsibility.

Trade Announcements.—Mr. T. J. Read, electrical engineer, of 94, Victoria Road, Swindon, announces that owing to his departure from the town he is giving up the business.

Mr. Fred Edmonds, electrical engineer, has commenced business at Highworth, Swindon.

Owing to heavy demands which have been made upon them for cables and flexible cords since German supplies were cut off, Messrs. Cave & Higgin, Ltd., have removed to larger premises at 19 Hardman Street, Manchester. They will forward particulars on application.

LIGHTING and POWER NOTES.

Aberdeen.—During February 1,118,630 units were generated at the municipal power station, an increase over the corresponding month last year of 104,750 units.

Australia.—The Launceston (Tas.) City Council has decided to ask the Government to submit terms and conditions for a supply of energy from the Great Lake plant. It is estimated that, at a cost of £60,000 for transmission, 10,000 H.P. could be brought to Launceston. Unless satisfactory terms can be obtained, an auxiliary steam plant will have to be installed.

The Maldon (Vic.) Shire Council has, owing to the prospect of an increased price for gas, decided to obtain particulars from other municipalities as to the cost of electric lighting.

The Dalby (Q.) Council has been granted an order authorising the installation of the electric light within the municipality.

The Table Bay (Tas.) Municipal Council is considering the question of borrowing £6,000 for the Wynyard electric lighting scheme.

The North Illawarra (N.S.W.) Council has decided to light the municipality by electricity, the work to be carried out when funds are available. It was also resolved that the various townships should be lighted on a ratepaying basis.—*Tenders.*

Aylesbury.—Public Lighting, &c.—The U.D.C. has decided to apply for a loan of £400 for street lighting by electricity. It is proposed to provide 62 new lamps and convert 31 existing gas lamps. A contract has been made with Messrs. Hazell, Watson & Viney, who have guaranteed to take not less than £200 worth of energy per annum. A loan of £250 is also to be applied for to cover the cost of wiring the Town Hall and adjoining premises; current for power will be available by the end of April.

Ballymena.—The B. of G. was recently informed by the L.G.B. that the provision made by Parliament for local loans was fully allocated, but if the Guardians were unable to obtain the £3,500 required for heating and electrically lighting the Workhouse and new hospital, they might renew their application to the L.G.B. in a month's time.

Barking.—Proposed Loan.—The U.D.C. has applied to the L.G.B. for a loan of £18,000 for extensions and additional plant at the electricity works.

Barnet.—Workhouse Lighting.—The B. of G. has decided to defer the acceptance of a tender for the electrical installation at the Workhouse for the present, those received being so much above the estimate. The North Metropolitan Electrical Supply Co. is to be asked to quote terms for a supply of current for lighting and power for seven or ten years.

Blackpool.—The output of the electricity works for February showed an increase of 27,985 units on February last year; this advance has been made despite the falling-off in the supply of 16,908 units for public arc lamps, and 8,700 units to the tramways. For the 11 months the total increase has been 353,356 units, although the public arc lamps show a decreased supply of 40,041 units.

Bolton.—Public Lighting.—The B. of T. has sanctioned the erection of overhead wires for the lighting of Long Lane, Breightmet, by electricity.

Boston.—L.G.B. Inquiry.—At an inquiry held on March 24th into the application of the T.C. for a loan of £3,600 for a refuse destructor, the inspector (Mr. R. H. Bicknell), intimated that the Council would not be able to get the money, because the Local Loans Commissioners would not grant it, and it would be very difficult to get it elsewhere until the Treasury had withdrawn its circular.

Broadstairs.—Public Lighting.—The U.D.C. has asked the Thanet Tramway and E.L. Co. to install a sample electric lamp in connection with its offer for public lighting where the mains run.

Easebourne.—Public Lighting.—The P.C. has received an offer from the Midhurst and District E.L. Co. to light the streets by electricity.

Eccles.—The terms on which the Manchester Ship Canal Co. is prepared to allow the Corporation to take water from the Bridgewater Canal for condensing purposes have been before the Public Lighting and Electricity Supply Committee, and the latter has decided to intimate that it cannot agree to the terms.

Finchley.—Coal *v.* Oil Fuel.—Messrs. Blackmore and Co., the District Council's contractors for the supply of coal to the electricity department, have intimated that they are unable to comply with the terms of their contract.

The electrical engineer reports that the deliveries of oil fuel were being satisfactorily maintained, and that this, together with the oil engine, was of the greatest assistance in the present situation.

Haslingden.—Loan Proposals.—The L.G.B. has notified the Corporation, in reply to an application for sanction to a loan of £12,000 for electricity extensions, that only work absolutely necessary should be proceeded with, and that capital expenditure should be limited as much as possible. The Electricity Committee has agreed to act in accordance with the communication.

Heston and Isleworth.—The Electricity Committee has decided to charge for current supplied to rifle ranges on the same basis as that fixed for power supply.

Hull.—Plant Extensions.—In connection with the proposed extensions of the electricity works, we understand from Mr. Magoris, deputy city electrical engineer, that the E.L. Committee was recommended to install the 5,000-KW. turbine set, one boiler and feed pump, and to defer for the present, a second boiler, cooling plant, coal-handling gear, &c. This modifies the information contained in our note published last week, which was derived from local sources.

Ilford.—The Electricity Committee has given instructions for all agreements in respect of wiring, fittings and apparatus on hire, agreements for maintenance, &c., to be terminated. In view of the great increase in the cost of coal, the electrical engineer recommends fitting two dry-back boilers with mechanical stokers.

India.—Cauvery Falls.—The chairman of the Nundydroog Co., Ltd., speaking at the annual meeting in London last week, referred to the slight increase in costs, which was attributable to a protracted drought occasioning a shortage of water in the Cauvery River during March, April, May and June, necessitating the use of steam power in place of electricity. Years ago, when they first discussed the question of introducing electric power, they told shareholders that the steam plant would be kept in repair, properly cleaned, so as to be used in any emergency. They, therefore, fell back upon it for several months. The Mysore Government was now constructing a large storage reservoir, which in due time would ensure a constant supply of power under the Cauvery scheme. It might not be entirely completed this year, but it would afford some additional protection, and under ordinary circumstances they need not look forward to a stoppage again on account of shortage of water.

A licence has been granted to Messrs. Crompton & Co. to supply electricity to the town of Agra.

Ipswich. — Three-Phase Extensions. — Extensions have recently been completed and put into operation whereby the whole of the eastern district of the town, which is largely residential, has been provided with an electric supply from four-wire, three-phase low-tension mains, the pressure being 400 volts between phases and 230 volts from any phase to neutral; 5·2 miles of main have already been laid. The district is supplied from two brick-built static transformer sub-stations, which are fed from duplicate three-phase feeders at 3,000 volts. On their way to the eastern district the duplicate feeders, which are each 2·75 miles long, are looped into a rotary converter sub-station in the foundry district,

designed to supplement the existing continuous current supply to the consumers in that neighbourhood. The three-phase supply at the power station is at present provided by a rotary converter, running inverted on the D.C. supply, and having a normal alternating-current output of 312 K.V.A. As a stand-by for this there is a 300-K.V.A. three-phase alternator connected to one of the original Reavell tandem compound three-crank engines running at 375 R.P.M. Automatic voltage regulation is provided for on both the rotary and alternator by means of a Taylor-Scotson regulator, this being the third of that make of regulator installed at Ipswich. The two rotary converters in the foundry district sub-stations are arranged for a normal output of 250 KW. The whole of the generating and converting plant has been supplied by the British Westinghouse Co., and the main switchboards have been supplied by the Switchgear Construction Co. The transformers in the static sub-stations have been supplied by Messrs. Ferranti.

Keighley.—The R.D.C. has given permission to the Corporation to lay a cable to the Keighley Joint Hospital, on the understanding that no supply is given to the East Morton Ward.

Kingston.—Increased Prices.—In accordance with the recent resolution of the Council, raising the prices of electricity for lighting, the E.L. Committee has increased the flat rate to 5½d. per unit, the m.d. rate to 7½d. and 3½d. per unit, the tariff to churches to 5d. per unit, and for public lighting by 10 per cent.

Leeds.—Permission has been granted by the Morley Corporation to the Leeds City Tramways Committee to lay cables giving a temporary supply of electricity to Messrs. A. Marshall and Sons, of Perseverance Mills, the newer portion of which are electrically equipped.

Leyton.—Proposed Loans.—The Electricity Committee of the U.D.C. recommends an application to the L.G.B. for sanction to loans of £17,158 for additional plant at the power station and £1,000 for services.

Llandudno.—New Plant.—The U.D.C. has decided, in view of the L.G.B.'s refusal to sanction a loan of £2,000 for extending the generating plant at the electricity works, to pay for the plant out of the reserve fund.

London.—The directors of the London Electricity Supply Companies have decided to raise the price of energy as from April 1st.

A new lighting order has been issued by the Commissioner of Police for the City, which amends the hours during which the inside lighting of shop fronts must be reduced, to from 7 p.m. till sunrise during the month of March, from 7.30 p.m. till sunrise during the month of April, from 8.30 p.m. till sunrise during the month of May, from 9 p.m. till sunrise during the month of June, and until further orders. This order, which came into force on March 22nd, does not affect the time fixed for the carrying of a red rear light by vehicles.

Poplar.—The Electricity Committee has had under consideration the question of the disposal of the surplus profits of the electricity undertaking, and also a profit-sharing scheme, and recommends that from April 1st the charge for private lighting shall be reduced from 5d. and 4d. to a flat rate of 3d. per unit, and for long-hour consumers from 2½d. to 2d. per unit net; domestic consumers' charge from 12½ per cent. on installation expenditure to 8½ per cent., and from £4 per KW. to £3 per KW. standing charge for general lighting purposes; also that a limited number of fans and radiators of standard type shall be loaned to consumers free of charge, in order to develop this class of supply. The Committee also reports that a reduction in the price of power can be effected in the near future if the policy of writing down capital in respect of obsolete plant is continued, so as to reduce the outstanding capital per KW. installed below £25. The Committee recommends, as a definite system of disposal of future profits, that after providing for all usual maintenance charges, and writing down service and instrument loans, the floating balance of the undertaking as set out in the balance-sheet of the annual report shall be at least equal to 10 per cent. of the total income in any year. Of the remaining balance, 40 per cent. shall be devoted to the relief of the rates, 40 per cent. be placed to the credit of machinery capital account to provide for obsolescence of plant, and 20 per cent. be dividend amongst the workmen and staff of the undertaking up to £1,200 and on further amounts the bonus be reduced one-half. It is proposed to appropriate an amount equal to a 1d. rate from the electricity fund for the relief of rates.

L.C.C.—The Treasury has drawn attention to the action of the Hackney B.C. in obtaining a loan of £10,000 from its bankers, which the Treasury had declined to allow it to borrow from the L.C.C.; although Treasury approval is not necessary in all circumstances before sums are borrowed by B.C.'s from their bankers, it should be understood that if a Council insists upon incurring capital expenditure against the wishes of the Treasury, which is acting with a view to the general interests of the nation in existing circumstances, sanction will not be given by the Treasury or the L.G.B. in the case of any further application for approval of borrowing for any purpose whatever.

The L.C.C. Finance Committee recommends the Council to sanction the borrowing of £4,000 by the Stoke Newington B.C. for mains and meters, providing the Council undertakes not to incur further capital expenditure which is not really necessary.

Stepney.—The B. of T. has approved the supplementary agreement with the Shoreditch B.C. for a limited bulk supply.

Mountain Ash.—Proposed Loan.—The U.D.C. has decided to meet the cost (about £550) for the provision of a sub-station in connection with the electric supply at Aberaman, out of the rates, and to apply to the L.G.B. for a loan of £2,650 for carrying out the other portion of the scheme.

Penzance.—The Penzance and District Electric Supply Co. announces that it is extending the mains in the town, particularly in the Lescud Jack district, and is wiring premises on the instalment system.

Perth.—New Plant.—The Electricity Committee recommends the purchase of certain generating plant at Loughborough, for £1,835; a deputation recently inspected the plant with a view to purchasing it, and thus avoiding further borrowing.

Portaferry.—E.L. Scheme.—The L.G.B. has granted the application of the Downpatrick R.D.C. for powers to carry out a lighting scheme for Portaferry. The area embraces the three townlands of Ballymurphy, Ballyphilip and Tullyboard.

Shipley.—Owing to the high price of copper, and the high rate of interest on loans, the Electricity Committee has deferred the carrying out of certain extensions for the present.

Upper Beeding.—Proposed E.L.—At a meeting of the P.C. on March 23rd, a letter was received from Mr. C. B. Oxley, of Steyning, offering to supply electricity for public lighting at 1s. per week per lamp, and also for private consumption. The Council decided to discuss the matter with Mr. Oxley at the next meeting.

TRAMWAY and RAILWAY NOTES.

Blackpool.—The total tramway receipts from April 1st last year to March 18th this year amounted to £74,393, a decrease of £8,724.

Chester.—Year's Working.—It is estimated that the gross profits from the tramways for the year just closing will be £5,087, as against £5,045 last year.

Colwyn Bay.—Tramway Extension.—The electric tramway line from Colwyn Bay to Old Colwyn has now been completed and fully equipped. The extension is nearly 2 miles in length, and will serve a considerable population on the route as well as the residential and industrial population at Old Colwyn and Llysfaen.

Continental.—Italy.—The Communal Authorities of Rome have been authorised to construct and work, by electric traction, an extension of the Piazza Colonna—Piazza Santa Croce tramway, and also an extension of the line from the Via Po to the Zoological Gardens. The "Società Elettrica Sarda" has also been authorised to construct and work an electric tramway system in the town of Cagliari.

Edinburgh.—Tramway Inquiry.—An inquiry has been held under the Private Legislation Procedure (Scotland) Act, into the prov. order promoted by the Corporation. A proposed tramway branch to Colinton Village and Redford Barracks was opposed by the Colinton Tramways Co. and the County Council. Mr. Cooper, K.C., explained the Corporation proposal to use self-propelled cars, and Mr. A. H. Campbell, the burgh engineer, gave evidence in support of the scheme. Mr. Stephen Sellon said he did not think the Corporation scheme would affect the company's scheme very much, but it would be better for the shareholders if the latter scheme disappeared. Mr. J. B. Hamilton and Mr. Shepherd (Edinburgh Tramways Co.) also gave evidence, while the County Council opposed on account of the narrow roads, and for the company it was pointed out that they hoped to commence construction before February, 1916.

Mr. Macmillan, K.C., for the Colinton Tramways Co., said the company had been authorised by Parliament to construct the line in the full knowledge that it was to be used as a track for the conveyance of material till the population came.

Mr. Cooper, K.C., for the Corporation, said that the T.C. might have been led to consider the purchase of the Colinton Tramways Co.'s undertaking, but it was resolved that under no circumstances would it take over the Colinton tramways along with the company's obligations to the War Office at this time.

The Court eventually decided that the Corporation be granted power to construct a line in the Corstorphine district and in the Colinton area, by Firhill, by circular route to the Braid Hills.

In regard to the portion of the route from Craiglockhart to Colinton, an offer was made by the Colinton Tramways Co. that the Corporation should purchase the rights there at £9,000, but this offer was refused by the Corportion, and that part of the route was withdrawn.

Glasgow.—Female Conductors.—As an experiment, and in view of the shortage of men, women conductors are being tried on the Corporation tramways.

Hull.—The T.C. is applying for powers to construct two additional lines of tramway in the city.

Ilford.—The U.D.C., last week, had a long discussion on a motion to the effect that, in view of the financial condition of the tramway undertaking, the best available expert advice be called in to assist the Council in formulating a scheme by which the undertaking can be placed upon a sound commercial basis. Owing to the lateness of the hour, the discussion was adjourned until the next meeting.

Lancashire.—In our issue of March 19th we stated that owing to recruiting, the number of men carried on the South Lancashire Tramway Co.'s system in the early morning and afternoon was showing a material shrinkage. We understand from Mr. E. H. Edwardes, the manager, that this is incorrect. As a matter of fact, the workmen's receipts happen to be above the average.

London.—The Finance Committee of the L.C.C. has received an intimation from the Treasury that consent will not be given to any municipal expenditure which is not actually necessary in the national interests. The Treasury is not able to approve of the Council's tramway scheme, involving a capital expenditure of £250,000, and suggests the slowing down of any municipal works now in progress.

Oldham.—The Tramways Committee has agreed to a proposal of the manager that Spencer air brakes should be purchased in substitution for the air brakes now in use. The change was recommended on account of the lessened cost of maintenance in the case of the Spencer brakes.

Salford.— Female Conductors.— Consideration has been given by the Tramways Committee to the question of employing women as car conductors, but it is felt that the scarcity of male labour is not yet so pronounced as to make the change necessary. Alderman G. T. Jackson, general secretary of the Amalgamated Association of Tramway and Vehicle Workers, has stated that his union will not object to the employment of women during the war only, but will insist that they shall be paid the same rates as the men whom they replace.

TELEGRAPH and TELEPHONE NOTES.

Japan.—The Japanese Government has been inquiring into the submarine cables laid by Germany in the Far East, which amount to a length of about 4,000 miles. The main cable extends from Kiaochau to Yap, Celebes and Guam *via* Shanghai. From Shanghai the lines are worked by the German-Dutch Telegraph Co., and cannot be confiscated by Japan. The line between Tsingtao and Chefoo, which extends for about 400 miles, and was operated by the German Government, was seized by Japan as a trophy of war on the fall of Tsingtao, and is now being used for official communications. The Japanese Government is considering the question of connecting the line with the newly-laid line between Shanghai and Nagasaki, with the view of facilitating telegraphic communication between Japan and China.

New telephone exchanges are being established by the Japanese Post and Telegraph Departments in the towns of Kitaku, Osaka, Rosokucho, Kanda and Tokio.

Wireless Telegraphists Wanted.— Wireless telegraphists between the ages of eighteen and thirty are wanted for the Royal Naval Air Service. Pay ranges from 4s. to 6s. a day, with all found. Applications should be made to the Recruiting Officer, Royal Naval Air Service, London Aerodrome, Hendon.

CONTRACTS OPEN and CLOSED.

OPEN.

Aberdare.—April 6th. U.D.C. Motor-generators or converters, one H.T. switchboard and L.T. panels, and one H.T. feeder pillar. See "Official Notices" March 19th.

Aldershot.—April 20th. U.D.C. One 400-kw. D.C. turbine set, complete with surface condenser and circulating pumps, &c. One water-tube boiler with chain-grate stoker. See "Official Notices" March 26th.

May 4th. Steam and other pipework. Water-softening plant. See "Official Notices" March 26th.

Australia.—Melbourne.—April 19th. 13,560 yards of lead-covered cable, for the City Council. See "Official Notices" March 26th.

April 19th. 13 tons of bare hard-drawn copper cable for the City Council. See "Official Notices" March 26th.

May 19th. Electric signals and spare parts (Contract 28,591), track transformers (Contract 28,359), electric train stops (Contract 28,590), all for a period of five years. Particulars at Contractors' Room, Spencer Street.

June 2nd. Electric lighting material for cars (Contract 28,187). Tender box, Railway Offices, Melbourne. Particulars at Contractors' Room, Spencer Street. Deposit ½ per cent. of amount of tender.

June 15th. Four mechanically-fired boilers, for the City Council. Specifications (£1 1s.) from the City Electrical Engineer.

Queensland.—June 1st (instead of March 16th). P.M.G. Switchboard for Warwick. See "Official Notices" March 26th.

Batley.—April 6th. Electric light installation at Batley Carr Wesleyan Sunday School. Mr. E. P. Lobley, Jesmond Dene, Birkdale, Dewsbury.

April 7th. Twelve months' supply of stores for the electricity works. Mr. D. Jones, Manager.

Bray.—April 6th. U.D.C. Stores for electric light works. See "Official Notices" March 19th.

Bridgend.—April 8th. U.D.C. 400-kw. steam alternator. See "Official Notices" March 19th.

Brighton.—April 12th. Corporation. Surface condenser. See "Official Notices" March 26th.

Bristol.—April 14th. Incandescent electric lamps (from local firms or from firms in a position to supply from local stocks), for the Docks Committee of the T.C., from May 1st to August 31st. Mr. T. A. Peace, Engineer.

London.—Southwark.—April 14th. Cable and meters, for the Borough Council. See "Official Notices" to-day.

Manchester.—April 14th. Corporation. Three 1,250-k.v.a. static transformers. See "Official Notices" to-day.

Rhondda.—April 17th. U.D.C. Installation, 83 wiring points, 88 lighting points, at the Council Offices, Pentre. See "Official Notices" to-day.

Sheffield.—April 12th. Supply of motor-van (petrol or electric) to carry one ton, for the Corporation. Specification (10s.) from the Cleansing Superintendent, Town Hall.

Whalley.—April 5th. Lathes, vices, electrical instruments, &c., for County Asylum. See "Official Notices" March 26th.

CLOSED.

Australia.—The following contracts have been placed :—

Melbourne City Council.—
5,000-kw. turbo-alternator, £15,111; spare parts, £1,015.—British Westinghouse E. & M. Co., Ltd.

Prahran and Malvern Tramway Trust (Victoria).—
Booster and switchgear, £920.—Noyes Bros. Pty., Ltd.

Shire of Nunawading (Victoria).—
Electric light poles, £379.—M. W. Clements.
Meters, £164.—Edison & Swan U.E.L. Co., Ltd.
Fuses.—W. T. Henley's Telegraph Works Co., Ltd.
Cables, £347.—B.I. & Helsby Cables, Ltd. —*Tenders.*

Municipal Council of Sydney; annual supplies.—
Wires and cables, schedule rates.—Henley's Telegraph Works Co., Ltd.
Fuse-boxes and fuses, £664.—Laurence & Hanson.
—*Aust. Mining Standard.*

Bolton.—The Electricity Committee has accepted contracts for 12 months' supplies as follows :—
Casings and covers.—F. J. Webster.
Jointing material and rings.—N. Isherwood.
Trough covers.—Bolton Brick Co.

Brighton.—The B. of G. has accepted the tender of Mr. H. J. Galliers, of Brighton, for electrical fittings, at £27.

Canterbury.—The B. of G. has accepted the tender of Mr. Terry for electrical work for the ensuing half-year.

Croydon.—The tender of Messrs. Callender's Cable and Construction Co., Ltd., has been accepted by the B.C. for the supply of electric cables to March 31st, 1916. This is subject to a contract providing for payment on a sliding scale based upon the market price of copper (reported to be about £70 per ton).

Ilford.—The following tenders have been accepted for annual supplies to the Electricity Department :—
Cables.—W. T. Henley's Telegraph Works Co., Ltd.
House-service fuse boxes.—J. H. Tucker & Co.; W. Lucy & Co., Ltd.
Joint boxes.—W. Lucy & Co., Ltd.
Incandescent lamps.—Crypselco, Ltd.; Electrical Manufacturing and Supplies; London and Rugby Engineering Co., Ltd.
Meters.—Ferranti, Ltd.; British Thomson-Houston Co., Ltd.; Electrical Apparatus Co., Ltd.

It has been decided not to enter into any contract for network boxes, but to order the boxes as required.

London.—Messrs. Napier & Kimber, Ltd., have obtained the contract for an electric lighting installation at the First Sea Lord's residence, for H.M. Office of Works.

L.C.C.—The Highways Committee recommends that the chairman and the vice-chairman of that Committee be severally authorised during the Easter recess to open any tenders that may be received in connection with the supply of cables required for the extension of the Woolwich sub-station, and to accept the most favourable tender or tenders.

Stepney.—The B.C. Electricity Committee reports the purchase of 4,500 tons of coal for the electricity undertaking in various lots, at prices varying from 18s. 5d. to 27s. 6d. per ton; and also recommends that a further offer of 2,500 tons of Barnsley Bed Top hard 1¼-in. nutty slack, at 19s. 6d. per ton, be accepted.

Woolwich.—The Electricity Committee of the Borough Council has accepted the offer of Messrs. Babcock & Wilcox, Ltd., to supply the additional shafts and uptakes for the two additional steam units, at £990.

Manchester.—Messrs. Chamberlain & Hookham, Ltd., have received a contract for tramcar meters for one year from the Corporation.

FORTHCOMING EVENTS.

Greenock Electrical Society.—Friday, April 2nd. At 7.45 p.m. At 21, West Stewart Street, Greenock. Social meeting.

Salford Technical and Engineering Association.—Saturday, April 3rd. At 7 p.m. At Royal Technical Institute, Peel Park. Paper on "Lifting Machinery," by Mr. D. Riley.

Institution of Marine Engineers.—Tuesday, April 6th. At 8 p.m. At Tower Hill, Minories, E.C. Paper on "Solid Fuel, from a Technical and Commercial Standpoint," by Mr. A. E. Battle.

North of England Institute of Mining and Mechanical Engineers.—Saturday, April 10th. At 2 p.m. At Newcastle. General Meeting.

Association of Engineers-in-Charge.—Saturday, April 10th. Social and Dance.

NOTES.

Geneva Water Supply.—Drinking water is raised to the city of Geneva by pumps installed in the Coulouvrenière power station on the Rhone below the city. The water is carried to these pumps by a conduit 4 ft. in diameter and 4 000 yards long terminating in Lake Geneva at a depth of nearly 50 ft. This conduit which is completely submerged, follows at first the bed of the Rhone, crosses the harbour and ends at the intake strainer, 2,200 yards from the jetty. At first water flowed into the conduit in sufficient quantity by gravity alone, but recent increases in the city's water consumption have made it necessary to supplement gravitational intake, at any rate during hot weather when the lake is low. Since suction applied to the delivery end of the conduit would have involved more or less in leakage of impure Rhone water or even mud, it was decided to force water into the conduit by a pump installed in the lake.

For this purpose an electrically-driven centrifugal pump was erected 50 ft. away from the conduit at a point 1.700 yards from the strainer intake, and where the lake is about 13 ft. deep. The pump suction and delivery pipes are connected in shunt to the conduit at points about 8 ft. apart between which is a valve closing automatically unless there is pressure on its up-stream face. When the pump is working this valve is closed; otherwise, the valve is open and water flows through the conduit by gravity alone. The vertical spindle centrifugal pump is direct coupled to an asynchronous motor above it, the whole being inside a sheet metal caisson 23 ft. in diameter at the base and composed of two truncated conical sections surmounted by a cylindrical section 8 ft. in diameter, which alone emerges at times of high water. Four manholes are provided in the cover, and a signal light indicates the position of the caisson by night. The caisson was assembled on the shores of the lake, towed about 2,000 ft. from the jetty, sunk by cement ballast and anchored by a ring of screw piles.

Running at 200 R.P.M. the pump discharges 14,600 gallons per minute against 10-ft. head. The squirrel-cage asynchronous motor mounted above it, in a carcass common to the two machines, develops 65 H.P., and is supplied at 2 000 volts, 40-cycles, from a special alternator in the Coulouvrenière station. This alternator generates at 2,100 volts, at 600 R.P.M., and is direct-coupled to a 105-H.P. Pelton wheel fed from the Geneva high-pressure water mains; a 5-H.P. exciter is driven in the same manner. With this arrangement operation is as simple as possible, the exciter being first started and the alternator and pump motor running up to speed together as the turbine valve is opened. Supply to the pump motor is through a three-phase cable, partly submarine; and automatic lubrication is ensured by a gear-driven pump.

Electricity in U.S. Steel Works.—Prior to 1914 the largest induction furnace used in the States had a capacity of only 2 tons, but last year two 20-ton furnaces were installed for steel refining, and these are the largest of any type now used in America for this purpose. The furnaces are of the two-ring type, and use single-phase current at the exceptionally low frequency of 5 cycles per second. The motor-generator employed has 4 000 K.V.A. output at 5,000 volts, and is direct driven by a three-phase 25-cycle 2,300-volt synchronous motor. The core and coils for each furnace weigh 60 tons, and the refining process, after charging with molten metal, occupies 60 to 90 minutes. The automatic control provided in the latest types of arc furnaces is particularly interesting to practical operators in that, except during a short period after starting the furnace, constant power input is maintained at any predetermined amount. Resistance furnaces utilising heat generated by the passage of current through a resistor of foundry coke, with auxiliary heating from a carborundum arch throwing heat downwards on to the charge, are also provided with relay control, maintaining constant temperature automatically at anything from 1,200 to 2,400° F.

Many modern rolling mills use electric motors exclusively for power purposes. Thus in the new works of the Bethlehem Steel Co., gas-driven alternators supply three-phase 25-cycle 6,600-volt induction motors, ranging from 350 to 3,000 H.P., and aggregating 12,000 H.P. The variable load of rolling mill machinery has proved a difficulty in the past, but the latest speed regulating equipment gives to induction motors the speed characteristics of D.C. shunt-wound machines, permitting them to carry variable load at constant speed, while retaining the mechanical strength and simplicity of the induction motor. Due to the availability of large quantities of power gas in iron and steel works, gas engine drive for electric generators is a specially tempting proposition, but one subject to well-known difficulties. Three 1,400 K.V.A. 2,300-volt 60-cycle units running at 116 R.P.M. were installed last year, and are believed to be the largest 60-cycle generators designed for gas engine drive, though 3,200 K.V.A. 25-cycle sets were previously installed at Bethlehem. The practicability of the large 60-cycle units is due to improved regulation and paralleling characteristics.

Miniature Rifle Ranges.—Few people, other than those who are actually members of Miniature Rifle Clubs, realise the enormous number of these clubs that exist in this country. In practically every village, town and city one or more ranges were to be found before war broke out, particularly in the Midland and Northern Counties, and since then numberless other ranges have sprung into being. That practice on these ranges is of great value when the marksmen take up the more serious work of service rifle shooting has been proved times without number; chiefly it is of value in accustoming the marksman to the handling of the rifle and to taking aim.

The new armies in process of formation have been largely trained on the ranges built by the War Office and on private ranges. One of the Manchester Pals Battalions (the 18th Manchester Service Battalion) has been through a complete course of

Westinghouse Rifle Range.

musketry on the range built by the British Westinghouse Co. in their works grounds at Trafford Park, Manchester. For many years a small range at the Westinghouse Club House has been in operation and well patronised by the members of that organisation, and this no doubt led, when war broke out, to the building of the more ambitious range, the firing point of which is shown in the accompanying illustration. No fewer than 36 men can shoot at one time on this range—10 at 25 yards and 26 at 50 yards. The cost of it, together with that of the rifles, telescopes, &c., was largely covered by the voluntary subscriptions of the employés, and a considerable part was built by them. The Westinghouse Co. gave considerable financial assistance and lent the grounds. In order to prevent any interference with recruiting, passes to shoot on this range were given only to those men who, for one reason or another, were ineligible to join His Majesty's Forces.

Legal.—Partners' Liability.—In the City of London Court, on March 26th, before His Honour Judge Atherley-Jones, K.C., a claim was made by Messrs. Rose Bros., 38, Beech Street, E.C., against Mr. Kohlhausen, the Hare and Hounds Hotel, East Sheen, to recover the sum of £8 18s. 4d. for electrical appliances supplied to him. Mr. Clements appeared for the plaintiffs, and Mr. Coupland for the defendant. Mr. Clements said that the plaintiffs were manufacturers of electrical appliances of various kinds, and the defendant owned the Hare and Hounds Hotel at East Sheen. In 1912 defendant combined that occupation with that of an electrical business proprietor. He bought the East Sheen Electrical Co., and plaintiffs supplied all kinds of electrical appliances to him. He told plaintiffs he was the proprietor of the business and gave them bankers' references. They took them up, and they had supplied him with goods for which he had paid. Defendant was known as the East Sheen Electrical Co., and he paid his accounts from time to time with his own cheque. In 1914 the goods now sued for were supplied to the order of the East Sheen Electrical Co. Applications for payment were made, and now defendant said he had ceased to be the company at the time the goods were ordered, and the plaintiffs must look to the present proprietors. Mr. Coupland stated that the defendant had never had the goods sued for. He was not now the East Sheen Electrical Co. Mr. Clements urged that that did not matter. Mr. Coupland said that the defendant was in partnership with one Woodruff. At the outset terms of credit were arranged, and plaintiffs should not have supplied the goods now sued for. Mr. Clements added that the orders were given by someone in the service of the East Sheen Electrical Co. Defendant had held himself out as proprietor of the company and was, therefore, liable by estoppel. Judge Atherley-Jones: You say that if a man disposes of his business he must let his customers know that he is no longer controlling it? Mr. Clements said that was so. Mr. S. J. Leaver, plaintiffs' manager, said he did not know even now that the defendant had ceased to be the East Sheen Electrical Co. Their traveller had gone to the war. Judge Atherley-Jones: Your traveller may have had notice of the change. Mr. Clements: Notice must be sent to the firm. Witness said he never knew that the defendant and Woodruff were in partnership. Defendant brought Woodruff with him, but defendant never said that all orders must be signed by himself. Defendant said he was not an electrician and he took Woodruff into partnership with him

because of his expert electrical knowledge. They took over the East Sheen Electrical Co. together, and he carefully told the plaintiffs when he called upon them with Woodruff that his (defendant's) signature was absolutely essential when orders were given for any electrical goods. He did that to safeguard himself. In September, 1913, he sold the business to one Satchwell, and Woodruff had been kept on as manager. He paid all his accounts that were outstanding. The goods sued for were supplied after he left. He did not advertise the dissolution of partnership with Woodruff in the *London Gazette*. Judge Atherley-Jones said it was an unfortunate case in which one of two innocent parties must suffer, and the burden was to be borne by the person who was guilty of the greater negligence. Defendant was a partner with another person, and was an exploiter of electrical goods. Under a trade name he dealt with the plaintiffs. He gave his name as the owner of the business, and therefore plaintiffs must look to him for payment although it might be he had not had the goods. The law was quite clear. Defendant had held himself out as liable, and must pay the plaintiffs. Defendant could easily have relieved himself from liability by intimating to the plaintiffs: "I have ceased to be a member of this firm, and you must not look to me any longer." That was the ordinary course followed by business people, but not by the defendant. He was reluctant to do so, but he must find for the plaintiffs. The affirmative was stronger than the negative. Judgment for the plaintiffs, with costs.

Russia and Municipalisation of Electricity.—Mr. K. Y. Zagorsky, in a report presented to the Imperial Technical Society on the proposed acquisition by the town of Petrograd of the electric concerns now in operation there on the basis of concessions, said that the chief motive for proposing to municipalise electrical energy was the numerous infringements of the concessions on the part of those now holding them; such as, for example, concluding monopolistic agreements with house owners, the limitation of the use of power of other companies, the rare application of the wholesale tariffs, and the failure to return discounts—and many other delinquencies. These and other considerations forced the town to consider the propriety of buying up the private electrical companies so as to centralise them, and thus safeguard the interests of the consumers, whilst at the same time securing an important source of revenue to the town. He held that the electrical business, like water and gas distribution, &c., stood apart from such businesses as might be the object of common industrial competition, which, in the cases mentioned, necessarily involved colossal outlays of capital to little useful purpose; when competition was allowed; whilst, on the other hand, the interests of the consumers were never consulted on their merits. He maintained that municipalisation meant cheaper current for subscribers and satisfactory financial returns to the town; and he believed that the existing tariffs to consumers could be reduced by 40 or 50 per cent., and the returns to the town be double those received from the companies now holding concessions. His report was directed chiefly to combatting the idea that the "1886 company" might be bought up, and the other companies allowed to operate independently; for, he said, these would become irritating competitors with the town.

L.C.C. Tramway Employés.—The Chief Industrial Commissioner on 17th ult. expressed the opinion that, in view of the terms of the Council's standing order, and of the facts of the case, the rate of pay for wiremen was correctly stated in the Council's list of rates of wages and hours of labour; also that the employés in the rolling-stock section, who were employed in workshops or the wiring of cars, were not entitled, under the Council's list of wages and hours, to the rate of 10½d. an hour. It was reported at Tuesday's Council meeting that the employés' representatives on the Conciliation Board had decided to abide by the Commissioner's award.

Educational.—University College, London.—The annual report of the University College Committee was received by the University Senate at their session on Wednesday last. The total number of students for the session 1913-14 was 2,206, including in the Faculty of Engineering, 134. For the current session, 1914-15, owing to the war, there has been a decline in the total number of 335; there has been an increase in the number of part-time and special students, the decline in full-time students up to the present date being 462. This decline is due to the large number of students who are taking an active part in the war. The Faculty of Engineering has been most affected, nearly all the second and third-year men having either taken commissions or enlisted. The fall in numbers will involve a decrease in fees of not less than £10,000. The report contains a summary of the work of last session, and also some particulars of the war activities of the College. The "Pro Patria" List already issued contains 665 names. A large number of Belgian Refugee Students has been received at the College, each student paying a merely nominal fee. The college staff, with the help of its friends, has provided hospitality, either partial or complete, for about 48 persons, and has raised a sum of nearly £300 to aid the students by providing money for their general expenses. All football has been suspended, and the Union Society's Athletic Ground at Perivale has been given over entirely to the purposes of a training camp, at which both students and members of the staff can receive military training. One former student, Capt. Martin Leake, who gained the Victoria Cross in the Boer War, has gained the Cross a second time "for most conspicuous bravery and devotion to duty throughout the campaign." Another student, Lieut. L. T. Despicht, has received the Military Cross "for conspicuous gallantry at Givenchy." The revenue of the College in 1913-14 was £71,567, and the expenditure £71,260. Members of the College have already indicated their willingness to assist in meeting the deficit created by the war. The completion of the new buildings has been delayed by the war. A special effort on the part of the Equipment and Endowment Fund Committee, of which H.R.H. Prince Arthur of Connaught is president, is to be made to raise the remainder of the sum necessary for the completion of the chemical laboratories. The sum still needed for this purpose is £13 650, the greater part of which (£10 000) is required for the special equipment of a physical and electrical chemistry laboratory. The national need of improved facilities for chemical education emphasises the desirability of completing the equipment of these new laboratories.

Institution and Lecture Notes.—Sheffield Electrical Social Union.—A new society of those engaged in the electrical trade in Sheffield has been formed with the above title. Its objects will be educational as well as social, and it will be open to electrical manufacturers and contractors, members of their staffs, Corporation and works engineers and assistants. Mr. B. E. Nicholson is secretary, and Mr. A. W. Gadsby, treasurer.

Diesel Engine Users' Association.—At the March meeting the question of the insurance of Diesel engines against breakdown, and the rates charged for this class of risk, was discussed. Particulars obtained in connection with a large number of Diesel engine plants showed that in many cases no insurance had been effected in consequence of the high rates charged by the insurance offices. The proportion of the amount insured to the total value of the plant concerned varied from about 18 per cent. to 66 per cent., the average being 35 per cent. of the total value of the engine. The ratio of the annual premium paid to the total value of the engine insured varied from about 1 per cent. to 3 per cent, and the ratio of the annual premium to the actual amount insured varied from about 3 per cent. to 7½ per cent. A scheme of insurance against breakdown was outlined under which members of the Association would be able to obtain advantageous terms, with a probability of a further reduction in the insurance rates later on after some experience had been obtained of the working of the scheme. One important advantage mentioned in connection with this proposal was that arrangements would be made for periodical inspections of the plant and for advice and reports by a fully qualified Diesel engine expert. At the present time the inspectors sent to make examinations by insurance companies, though thoroughly qualified as steam engineers, were usually not acquainted with the peculiarities of Diesel engines. After some discussion the proposal was referred to the Committee of the Association for further consideration. It was understood that a standard Diesel engine policy would be submitted, as well as more definite particulars as to the rates which it was proposed to charge. The next meeting of the Association is to be held on Wednesday, April 21st, when a discussion will take place on the lubrication of Diesel engines. Information and particulars concerning the Association can be obtained from the acting hon. secretary, Mr. Percy Still, at 19, Cadogan Gardens, S.W.

Royal Institution.—The day lectures after Easter include Prof. Fredrick Soddy, two lectures: "Advances in the Study of Radio-active Bodies." Prof. J. O. Arnold, two lectures: "The Evolution of Steel: Influence on Civilisation." Dr. A. W. Porter, two lectures: "Advances in General Physics." Prof. J. A. Fleming, two lectures: "Photo-Electricity" (The Tyndall Lectures).

Institution of Electrical Engineers.—The following are the Council's nominations for election to the Council for the year commencing October 1st, 1915:—

President (one vacancy).—C. P. Sparks.

Vice-Presidents (two vacancies).—
Dr. A. Russell. R. T. Smith.

Honorary Treasurer (one vacancy).—R. Hammond.

Ordinary Members of Council.—Members (five vacancies).—

W. A. Chamen.	H. F. Proctor.
H. Dickinson.	G. S. Ram.
H. W. Firth.	W. Slingo.
Prof. T. Mather, F.R.S.	A. H. Walton.

Associates (one vacancy).—J. Hunter Gray.

The following members remain in office:—

Vice-Presidents—
J. S. Highfield. C. H. Wordingham.

Ordinary Members of Council—

F. E. Berry.	A. W. Martin.
R. A. Chattock.	A. M. Ogilvie, C.B.
J. Christie.	G. W. Partridge.
E. Russell Clarke.	W. H. Patchell.
Major E. O. Henrici, R.E.	R. J. Wallis-Jones.
Prof. B. Hopkinson, F.R.S.	W. B. Woodhouse.

It was the unanimous desire of the Council to nominate the President, Sir John Snell, for a second year of office; but the President, while thanking the Council for the honour, expressed his regret that for reasons of health, and on account of the claims of his professional work, he would be unable to accept nomination

Electrical Heating and Cooking Apparatus.—In a paper which Mr. Stanley M. Hills, A.M.I.E.E., is reading before the Junior Institution of Engineers on Monday, April 12th, he proposes to give a description of the various radiators, convectors, &c., the heating of rooms and offices, hotplates, grills, ovens, energy consumption of a cooker, utensils, and running costs. Tickets can be had from Mr. A. Clifford Swales, secretary, 39, Victoria Street Westminster.

Delays and Discounts.—At Church Police Court (Lancs.) last week, James Clayton, landlord of the Queen's Hotel, Church, was summoned by the Accrington electricity department for non-payment of an account for electricity. It was stated that the amount in question was 13s. 9d., the balance of an account for electricity, for the quarter ending September last. Defendant had deducted this amount for discount to which he was not entitled. The last date for discount was November 23rd, and the cheque was received on the afternoon of November 24th, and plaintiffs contended that it was evident that the cheque had not been posted until the morning of the 24th. Defendant admitted that he could not prove that he posted the cheque on the 23rd. An order for payment was made, with costs.

Municipal Competition.—Mr. R. C. Walsham, speaking as president of the National Chamber of Trade at Lancaster, said the sale of electrical fittings by municipalities was interfering with the rights of private traders.

1st London Engineers.—New Field and Signal Companies (212 and 240 men respectively) are again being raised by the 1st London Divisional Engineers (T.F.), as three of their units have already gone abroad on active service. Smart intelligent men are wanted—for the field companies, men connected with the building and constructional iron trades, all-round electricians, &c., and for the signal companies, young men of good education, especially telegraphists, electricians, instrument makers and telephone operators, all of whom are taught to ride. The work is very interesting, and the pay is considerably higher than in most other arms of the service. Application should be made to the headquarters, 10, Victoria Park Square, Bethnal Green, or to the branch recruiting office, Labour Exchange, Edgware Road.—*Standard.*

A Siemens Social.—The Siemens Dalston Miniature Rifle Club has been well supported during the past four years, and the present season's membership forms the record since its inception. Some 23 past members of the Club are now serving with the Forces, which makes the present membership of the Club all the more satisfactory. A Social Evening was held at Mozart House on Friday, March 26th, under the auspices of the Club, and a party of about 150 club members and their friends experienced a very enjoyable evening. Mr. A. B. Holmes distributed the medals and spoons won during the current half-season. Vocal and instrumental items were interlarded with dancing, and an extremely long programme was put through between 7.30 and 12 p.m. The arrangements were in the hands of the Club Committee, and Mr. F. S. Dennison acted as hon. M.C.

Private Arrangement.—W. A. Boissier, electrical engineer, East Street, Derby.—The creditors interested herein were called together recently, when a statement of affairs was presented showing liabilities of £1,956, of which £751 was due to the trade, and £1,205 to cash creditors. The assets were estimated to realise £456, from which had to be deducted £6 5s. for preferential claims, leaving net assets of £450, or a deficiency of £1,506. The debtor, who was only 24 years old, commenced business in April, 1910. He had little or no capital of his own, but his father-in-law advanced him various amounts. The debtor had prepared rough trading accounts at various dates, and they showed that a profit was made in the business. An offer was made of a cash composition of 6s. 8d. in the £. An increased offer was pressed for, and eventually 7s. 6d. in the £ was offered, and was accepted by the creditors.

Appointments Vacant.—Electrician (£80 +), for Clonmel District Lunatic Asylum; switchboard attendant (27s. 6d.), for Borough of Lancaster. Particulars are given in our advertisement pages to-day.

The I.M.E.A. Development Committee.—At the meeting of this Committee held on March 12th, reports were received from the several Sub-Committees, whose operations have to a considerable extent been interfered with by the difficult conditions existing at the present time. The question of the production of printed publicity matter received attention.

The possibilities and limitations under which municipal electric supply undertakings work to-day were dealt with at some length for the benefit of the considerable number of co-opted members who were present, and who offered suggestions and assistance which were much appreciated.

It is anticipated that some more or less workable scheme for carrying on publicity work by means of printed matter, Press advertisements, &c., will shortly be brought before the full Committee.

Mr. H. C. Palmer (of the General Electric Co.) and Mr. L. G. Tate were co-opted members of the Publicity Sub-Committee.

Further discussion arose around the work of the Sub-Committees on "Domestic Appliances" and "Electrical Installations" (Hon. Secs. Messrs. Roles and Allen); and proposals from these gentlemen were considered.

It was understood that these and other similar Sub-Committees would probably be able to carry on a very considerable amount of valuable work of a definite character in the direction of collating and analysing the mass of information at present existing amongst engineers and manufacturers on the subjects dealt with by the Committees, and that the results of such investigations would be available to the full Committee, and also would form useful matter for the guidance of the operations of the Publicity Committee. A further question of making such information generally available for manufacturers and the electricity-using public received consideration, and will be referred to again later.

A Question of Means.—In Croydon Police Court on Monday the question of the means of Norman D. Frost, a canvasser in the employment of a London electrical supply company, was being discussed so as to enable the Bench to arrive at a sum to be allowed his wife under a separation order, he being the defendant. He said he received £2 2s. weekly and travelling expenses, the maximum being 6s. weekly. There was no commission. His duty was to advise people about electric light installations. Complainant's solicitor: Have you borrowed money from electricians? Defendant: Yes. The solicitor: And you have never paid it back? Defendant: No, because I have not been requested to. The solicitor: But you know perfectly well this money is lent? Defendant: Yes, but they never ask it back. Pressed further, defendant said the last sum of the kind received was about £2. He could not give the exact date of the transaction; it was sometime before Christmas. The clerk: Did you give an I.O.U. for it? Defendant: I gave nothing for it. The solicitor: How much a year did you get in loans of this sort? Defendant: At the outside, taking the year right through, I should say £6; that is the best I have done. Defendant admitted having borrowed from other tradesmen not electricians, but denied that it was within his power to give them work. The Solicitor: Do you say, "Go to Mr. So-and-So for your work; he is the finest electrician in the town?" and then go yourself to Mr. So-and-So and say, "Lend me a fiver?" Defendant: I do nothing of the kind. The Solicitor: Is it a fact that you are able to put work in the way of electricians? Defendant: If I cared I could put work in the way of a great many people. Defendant was ordered to pay his wife 15s. a week, and the solicitor hoped his employers would come to hear of his statements.

Fatality.—Langley.—On March 24th, at the works of Messrs. Albright & Wilson, at Langley, James Wilcox (19), who was engaged on a railway siding which runs into the works, was found lying on the floor and clutching a "live" electric wire which passed over the spot into an adjoining factory. Dr. Broughton was summoned, and attempts were made to restore animation, but without success. Another man who released deceased from the wire experienced a shock, but quickly recovered. It is surmised that while deceased was throwing a cover over the truck on which he was standing he slipped, and in falling clutched the wire to save himself.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station Officials.—The York Corporation has granted increases of salary to the following employés in the electricity department:—Mr. S. Spofforth, Mr. Peterkin (draughtsman), Mr. E. M. Pearson (mains superintendent).

Mr. E. W. Martin, assistant distribution engineer in the Woolwich electricity department, has been promoted to the second class of the engineering staff in that department, and his salary has been increased to the maximum of such class, viz., £150 per annum.

The Ilford Council has been recommended to increase the salaries of Mr. R. F. Windett, meter superintendent, and Mr. E. W. Fowebaker, fourth charge engineer.

Mr. William Chamberlain, mains superintendent engineer in the Oldham Corporation electricity department, was married last week to Miss Lilian Hood, daughter of the late Ald. Hood, a former Mayor of the borough.

Mr F. Spink, Works Superintendent of the Worksop Electricity Works, has recently resigned his appointment, and has entered the Navy, as an Electrical Artificer, for the period of hostilities.

Tramway Officials.—Mr. Dugdale, the general manager of the Oldham Corporation tramways, who has been ill for some time, is now very much improved in health.

Dover Tramways Committee has appointed Mr. Bond, of the Colchester tramway staff, as depôt foreman.

General.—The marriage took place at St. Bartholomew's Church, Ruswarp, on March 22nd, of Mr. William Henry Atkin, electrical engineer, of South Bank, and Miss Edith Porritt youngest daughter of Mr. William Porritt, of Ruswarp.

The Special Committee of the L.C.C. on London Electricity Committee recommends that Mr. G. M. Gillett, Mr. H. H. Gordon and the Hon. Gilbert Johnstone be appointed members of that Committee.

Obituary.—We regret to learn that Mr. Matthew Thomas Medway, founder and head of the Medway's Safety Lift Co., Deptford, S.E., died at Brockley on March 22nd. He was 65 years of age.

Prof. Henry Robinson.—We regret to learn that Prof. Henry Robinson, M.Inst.C.E., Emeritus Professor of Civil Engineering at King's College, London, passed away in London on March 24th. In the earlier days of electricity supply the late Professor was prominently associated with the design and installation of a number of undertakings in London and the provinces.

Wills.—The late Dr. Anthony Traill, Provost of Trinity College, Dublin, left £6,779.

The late Mr. J. F. Albright left £32,601 net and £33,854 gross personalty.

NEW COMPANIES REGISTERED.

Hubert D. Carter, Ltd. (139,734).—This company was registered on March 23rd, with a capital of £5,000 in £1 shares (2,000 7 per cent. cum. pref.) to carry on the business of gas, electrical, motor and hot water engineers and fitters, lighting contractors, plumbers, manufacturers of wire, screws, nails, rivets, nuts, bolts and electrical equipment of all kinds, etc., to acquire the business carried on by H. D. Carter at Colwyn Bay. The subscribers (with one share each) are: H. D. Carter, Crosley House, Colwyn Bay, electrical engineer; C. L. Williams, Bolton Villa, Colwyn Bay, secretary; W. E. Buckley, Beech House, Colwyn Bay, gent. Private company. The number of directors is not to be less than two or more than five; the first are H. D. Carter (permanent managing director, special qualification 500 shares) and others to be appointed by the subscribers. Qualification of directors 10 shares. Remuneration of managing director, £150 per annum and a percentage of the profits. Solicitor, E. A. Crabbe, Cronhaulog Chambers, Abergele Road, Colwyn Bay. Secretary, H. D. Carter. Registered Office: Sea View Terrace, Colwyn Bay.

Cark and District Electric Supply Co., Ltd. (139,728).—This company was registered on March 23rd, with a capital of £2,000 in £1 shares (1,500 6 per cent. cum. pref.), to carry on at Cark, Flookburgh, Allithwaite and adjoining district the business of an electric light supply company in all its branches. The subscribers (with one share each) are: C. H. Best, 72, Market Street, Bradford, incorporated accountant; G. Dickinson, Cark Mills, Cark-in-Cartmel, corn merchant; F. Wilkinson, Bankfield, Allithwaite, colliery agent. Private company. The number of directors is not to be less than three or more than five; the subscribers are to appoint the first. When there are only three directors, two shall be holders of ordinary and one the holder of preference shares; when there are five, three shall be holders of ordinary and two the holders of preference shares. Qualification £25. Remuneration as fixed by the company. Solicitor, F. W. Poole, Ulverston, Lancs.

Roto Engineering Co. (Bradford), Ltd. (139,737).—This company was registered on March 23rd, with a capital of £1,000 in £1 shares, to carry on the business of electrical, mechanical and ventilating engineers, merchants, manufacturers of rotary pumps, oil cabinets ers and other appliances, steam, hydraulic, pneumatic or other engine . The subscribers (with one share each) are: H. Hornby, 2, Clarend treet, Bradford, iron merchant; F. Laycock, 92, Beech Grove, Lidget Green, Bradford, managing clerk. Private company. The number of directors is not to be less than two or more than 5; the subscribers are to appoint the first. Qualification, 50 shares. Remuneration as fixed by the company. Solicitor, A. V. Hammond, Dale Street Chambers, Bradford. Registered office: Borough Mills, Bradford.

OFFICIAL RETURNS OF ELE RICAL COMPANIES.

Rhondda Tramways Co., Ltd.—Particulars of £250,000 debentures, created by resolutions of March 13th, 1911, November 8th, 1912, and February 4th, 1915, and secured by trust deeds dated March 24th, 1911, November 13th, 1912, and March 11th, 1915, filed pursuant to Section 93 (3) of the Companies' (Consolidation) Act, 1908, the amount of the present issue being £10,000. Property charged: The company's undertaking and property, present and future, including uncalled capital and tramways and right of user or same, and lands with generating station and other premises thereon, together with equipment of tramways, and all purchase moneys to be received from Rhondda Urban District Council, etc. Trustees: Law Debenture Corporation, Ltd., 41, Threadneedle Street, E.C.

Corona Lamp Works, Ltd.—Issue on 27th February, 1915, of £4,350 debentures, part of a series of which particulars have already been filed.

Newcastle-upon-Tyne Electric Supply Co., Ltd.—Charge, as substituted security, dated March 4th, 1915 (supplemental to trust deed dated October 16th, 1913, and acknowledgment of indebtedness dated November 10th, 1914, securing £500,000 deb. stock). Property charged: All shares in capital of Carville Site and Power Co., Ltd., which may during the continuance of the security constituted by the trust deed be acquired by the company. Trustees: Law Debenture Corporation, Ltd., 41, Threadneedle Street, E.C.

Naylorgraph, Ltd.—Two debentures, dated 13th March, 1915, to secure £576 and £100 respectively charged on the company's undertaking and property, present and future, including uncalled capital, if any, subject to prior debs. Holders: J. M. Hunt, Fairlawn, Park Road, Southborough, and J. P. Naylor, 57, Croxted Road, Dulwich, S.E.

CITY NOTES.

North Metropolitan Electric Power Supply Co., Ltd.

Mr. E. Garcke presided on March 25th over the annual meeting, held at Electrical Federation Offices, Kingsway. He said that last year they sold 36,800,000 units of electricity, an increase of 2,400,000, or about 7 per cent. The increase would have been much larger but for the outbreak of war, for in the first half of the year the increase was 2,800,000 units, but in the second half there was a diminution of over 400,000 units, and that notwithstanding that the second half of the year was usually better for the electricity supply business than the first half, especially where current was supplied for working tramways. The North Metropolitan Electric Tramways, for which they supplied current, ran fewer car miles and consequently consumed less energy, and the various power users in the district also reduced their consumption. Although the increase in the volume of business was less than the normal increase in previous years, they had obtained a revenue of £173,000 compared with £164,000 for 1913, and had made over £3,000 more profit. He thought that, having regard to all the circumstances, the result of the year's working must be considered satisfactory, especially as several items of expenditure had increased owing to rises in prices. They had had to spend over £50,000 on coal, compared with about £47,000 in 1913. The balance to net revenue was £92,791. After providing for mortgage, loan and debenture interest and transferring £2,000 to the reserve to secure the redemption of the debentures, and placing £1,624 to the depreciation account—raising it to £100,000, writing off the whole of the preliminary expenses, amounting to £14,941, there was sufficient to pay the 6 per cent. cumulative preference dividend for the year, the same dividend on the ordinary shares as a year ago, leaving £4,676 to be carried forward, compared with only £1,054 brought in from the preceding year. They had thought it wise to write off the whole of the preliminary expenses instead of further increasing the depreciation reserve, seeing that the depreciation fund now amounted to £100,000, which they considered an adequate reserve for the time. They had also thought it wise to carry forward a larger amount of undivided profit in view of the general uncertainty as regarded the profit which might be earned during the current year. The dividend on the preference shares had absorbed £5,000 more than in 1913, which arose in consequence of their having issued £100,000 additional preference share capital during the past year in order to provide for capital expenditure rendered necessary by the extension of their power houses and the laying of a main trunk cable from their Willesden power house, through Wembley and Pinner, where they were now supplying electricity in bulk for lighting purposes. The capital expenditure during the year had amounted to £83,295. The shareholders would be interested to know that the company's business continued to develop satisfactorily. They had recently made several contracts with new power users, and the general manager was in communication with several other factories for the supply of electricity. The electricity distribution business of their subsidiary company was also progressing satisfactorily, and they had received dividends of 6 per cent. for the year upon their investments therein. At the last meeting he referred to the subject of the London electricity supply situation and stated that fortunately they were outside that controversy, and that therefore it was not necessary for them to discuss it. Soon afterwards, however, a Bill was promoted by the L.C.C. which proposed to deal not only with the situation in London, but which also proposed to take powers to enter the area which they now served outside London. The Bill was not proceeded with owing to the Council being unable to obtain the necessary approval required by the Borough Funds Acts. They were assured, however, that if the Bill had been proceeded with there was no reason to anticipate that they would have failed to obtain a clause fully protecting their interests; and, considering that they were working under statutory powers, which placed them under heavy obligations, and that they were serving the public satisfactorily, the directors felt that the company was not only entitled, but was bound to be prepared, to take all necessary steps for the safeguarding of its rights and interests. Having referred to the retirement of Mr. George Richardson, who had been a director of the company since 1903, the Chairman said that the directors and shareholders were indebted to the staff for the admirable way in which they had performed their duties during the very trying period since the outbreak of the war. 23 per cent. of the staff of their own company and of its subsidiary company—the North Metropolitan Electrical Power Distribution Co.—were now serving in either the Army or the Navy, and included among the officers was Mr. Boyes, their secretary. Those remaining at home were subscribing to a joint fund which the associated tube and tramway companies had inaugurated for the purpose of providing assistance for the dependents of those employés who had joined the Colours. The company had also joined in the contributions made to the various war funds by the British Electrical Federation.

Sir Ernest Spencer seconded the resolution and the report was adopted.

London and Suburban Traction Co., Ltd.

The Rt. Hon. C. B. Stuart Wortley, K.C., M.P., presided on Friday last over the annual meeting held at the Holborn Restaurant. The Chairman said that in the case of the tramway and omnibus companies in which they were interested, their total traffic receipts amounted to £1,303,900 odd, against £1,152,494 in 1913. The passengers carried were 246,800,000, against 218,900,000. The electricity supply companies in which they were interested sold a total of 39,510,000 units in 1914, as compared with 36,904,000 in 1913. Their total income from their holdings in the various subsidiary companies was £107,884, plus £10,593 for interest on money which they had lent to the companies. That compared with £98,825 and £5,309 respectively in the previous year. Including sundry receipts the total revenue was £118,579, against £105,370 in 1913. On the other hand, the administrative and general expenses had amounted to £2,077, against £1,980. They had had to find for interest on debenture stocks, original and new, £18,695, against £5,094; and for interest and other moneys borrowed £5,555, against £7,013. Including the item of £6,200 put aside as a sinking fund for the redemption of the 5 per cent. debenture stock, the total expenses for 1914

amounted to £34,955, against £17,018 for 1913. The result was that they had been able to pay the full dividend on the cumulative preference shares amounting to £80,110, as well as £9,226 for dividend on the ordinary shares for the first half of the year at the rate of 1 per cent. per annum, and carrying forward £2,886, against £8,597 last year. The shareholders would see that in the first half of 1914 they had a fair prospect of realising the hopeful anticipations in which he indulged at the last meeting. It was in the early days of July and before the outbreak of war that they declared the interim dividend. The final results for the year showed that though the effect of war on the various subsidiary companies had undoubtedly been adverse, it might well have been worse than it was. It had certainly removed from the streets a large number of omnibuses which competed with the tramways of many of their subsidiary companies, and to that extent it had helped them. It was, of course, impossible to say what their experiences would be during the remainder of the war, but he thought they were justified in hoping that a return to peace conditions would mean for them a return to the modest kind of prosperity which the first half of 1914 seemed to promise. Out of 4,186 employés in the associated companies no less than 1,110 had joined the Forces, which was 24 per cent. of the whole. The company was throwing in its lot with the T.O.T. Mutual Aid Fund, which was looking after the dependents not only of the underground railway and tramway men but of the men in power houses as well who had joined the Colours.

Mr. E. Garcke seconded the motion.

Replying to a shareholder, the Chairman said he was given to understand that the chairmen of subsidiary companies were satisfied that a sufficient amount had been set aside for depreciation in regard to each concern.

The report was adopted.

Liverpool District Lighting Co., Ltd.

The annual meeting was held on March 24th, Mr. W. A. Cookson presiding. The Secretary read a statement from Mr. Charles McLaren (the Chairman, who was indisposed) which said that the war had retarded business during the second half of the year, and instead of an estimated increase of 50,000 units sold they had increased the sale by only 31,279 units, which, considering all things, was a very creditable result. The profits, which had increased by £744, amounted to £5,422, which, after deducting the interest paid on bank overdraft, was exactly equal to 8 per cent. of the ordinary capital. They had had to pay a higher rate of interest, more income tax, and they had also paid the wages of their employés who had joined the Colours, who numbered one-third of the staff. They did not anticipate any serious capital expenditure during the present year. By an agreement with the Hightown Gas & Electricity Co. they were now supplying them in bulk for distribution and sale in their own district of Hightown, and in this way they were supplying a large military camp at Sniggery Woods, and also the battery at Hightown. They were also supplying by arrangement electricity to another camp situated at Thornton, about 220 yds. beyond their boundary. That would make up for the economies practised by their existing consumers, but they could not look forward to any substantial increase of business during 1915. They had always been handicapped by want of coal storage bunkers capable of holding 500 or 600 tons, and consequently were apt to be hit by strikes of workmen, and now by the war. Their engineer was preparing a report and plans suitable for coal storage bunkers, and if they found it was in any way possible to erect them at a reasonable cost they intended to make themselves independent of the fluctuations in the coal trade. Doubtless many shareholders would think that having made profits equal to 8 per cent. of the capital a dividend of 5 per cent. might be paid, but the directors after due consideration decided that this time of national crisis was not the time to increase dividends.

Cleveland and Durham Electric Power, Ltd.—The directors report that during 1914 the capital expenditure on works was £14,915. The gross profits, which have been adversely affected by the war, amounted to £36,839. After providing for debenture interest the net profit is £16,826, plus £8,799, brought forward. The directors propose a dividend of 4 per cent. on the preference shares, transferring to depreciation and renewals account £3,000, reducing expenses of issue of debentures by £1,000, and carrying forward £ 8,277.

Wm. Beardmore & Co., Ltd.—The *Times* states that the profit for 1914 amounted to £219,142 (against £164 236), and £186,947 was brought forward. The directors place £50,000 to special preference dividend reserve, and, after paying the year's dividend on the preference shares, recommend a 5 per cent. dividend on the ordinary shares, leaving £193,089 to carry forward. For the preceding year the dividend was the same.

Vickers, Ltd.—In consequence of the great pressure due to the war, it has been found impossible to complete the yearly accounts for presentation at the usual date. In the meantime, the final dividend of 5 per cent. on the preferred 5 per cent. stock and on the 5 per cent. preference shares have been paid.

Altrincham Electric Supply, Ltd.—We have now received a copy of the report which was adopted at the annual meeting held last week. There were 88 new installations connected to the mains during 1914. The accounts showed a profit of £8,349. Including £2,776 brought forward the amount available for distribution was £9,612. Balance of preferred dividend required £1,059, there was put to general reserve £500, and to depreciation of machinery account £1,500, leaving £5,503, out of which a dividend of 10s. per share upon the deferred shares. Mr. F. O. Arnold has been elected a director. We understand that the progress of the company was arrested by the war. For the first month or so of war the power loads showed a diminution owing to short time in the factories, and when Government work was freely given out towards the end of the year there was a lack of men in the workshops, and this fact then and still prevented the company from reaping the benefit that would have ensued from overtime. The actual output was less than in 1913 owing to consumers' household economies and the shorter hours on power loads. Working expenses were, however, reduced in spite of an increase of 11 per cent. in price of coal. It is interesting to learn from Mr. G. H. Fawcus, the engineer and manager, that he has one large farm on the mains for both power and lighting, and one more at least is coming on within the next few weeks.

Newmarket Electric Light Co., Ltd.—The annual meeting was held recently, Mr. F. E. Gripper presiding. The directors' report stated that during 1914 the equivalent of 1,015 33-watt lamps had been connected, making the total 30,744 lamps. The profit on the year's working, with £146 brought forward, amounted to £2,464, and after deducting £733, debenture and other interest, £1,731 remained available. The directors recommended a dividend of 3½ per cent., £650 being carried to reserve for renewal of plant, leaving £151 to be carried forward. Mr. Gripper said that the dividend recommended was ½ per cent. less than last year. But for the war they would have had a record year. Receipts from sales of current had fallen off; also receipts from wiring account by £145. Expenditure had increased by £40, this being mainly due to rates and taxes. The balance available for distribution was less by £228 than last year. The report was adopted.

American Telephone and Telegraph Co.—The report states that the net earnings were $40,557,977, or approximately the same as in the previous year. The interest charges were $8,223,163 and the dividends at the regular rate of 3 per cent. per annum were $27,572,674. Of the resulting balance there was carried to reserves $2,500,000 and to surplus $2,262,139. At the end of the year the number of stations which constituted the system in the United States was 8,648,993, an increase of 515,976, including 168,177 connecting stations; 2,885,985 of these were operated by local, co-operative and rural independent companies or associations having sub-licence or connection contracts, so-called connecting companies. The Bell telephone toll lines of the United States now reach 70,000 places, from substantially all of which messages can be telephoned to the nearest telegraph office.—*Financial Times.*

Companies Struck Off the Register.—The following companies have been struck off the Register, and are accordingly dissolved:—

British Tungsten Metals Syndicate.
Electrical Regulators and Economisers.
Frank Suter & Co.
Gorwitz & Co. Aluminium Fabrik Weilar (Rhon) Aktiengesellschaft.
Indestructible Accumulators
Indicating Fuse and General Manufacturing Co.
International Electric Transport and Enterprise Co., of Alsace Lorraine.
Kellogg Manufacturing Co. (Europe).
Leeds and Bradford District Electric Railways.
Reis Oil Fuel, Gas Producer and Burner.
Scientific Illumination.
Telephone Disinfecting Co.

Clyde Valley Electrical Power Co.—The report for the half-year ended December 31st last states that the profit amounts to £37,662, plus £37,662 brought forward. After payment of the dividends on preference shares to October 31st, 1914, amounting to £9,000, and after adjusting interest and transferring £12,500 to contingency fund for depreciation, &c., there remains £33,826. The directors recommend that £3,290 be transferred to special reserve, £10,000 applied in writing down cost of Acts, 1901, 1904 and 1912, and £9,000 provided for the dividend on preference shares to April 30th, 1915, leaving £11,535 to be carried forward.

Gateshead and District Tramways Co., Ltd.—A dividend at the rate of 6 per cent. per annum, and a bonus of 6s. per share (together 12s. per share), on the ordinary shares, making 9 per cent. for the year, are announced.

Stock Exchange Notice.—The Treasury has authorised dealings in the following securities:—

Bombay Electric Supply and Tramways Co., Ltd.—12,000 "new" ordinary shares of £10 each.

Howard & Bullough, Ltd.—An interim dividend at the rate of 10 per cent. per annum, less income-tax, on the ordinary shares is announced for the past quarter.

Company Meetings.—The annual meetings of the British Westinghouse Electric and Manufacturing Co., Ltd., and the Brush Electrical Engineering Co., Ltd., were held on Monday in London. We shall report the proceedings in our next issue.

United Tramways, Ltd.

Mr. W. M. Acworth presided, on Friday last, over the annual meeting held at Electrical Federation Offices, Kingsway. The Chairman said that the shareholders outside the London and Suburban Traction Co. only held about 3 per cent. of the stock. The work of the reconstruction of the Hammersmith lines had been completed, bringing up the expenditure to £62,000. Pending the completion and sale of those lines to the L.C.C., they were paying interest and sinking fund charges upon the amount advanced for the reconstruction, £12,500 had been appropriated to reserve for reconstruction and renewals out of profits, while £29,000 had been charged against that fund. That amount was almost wholly represented by the reconstruction of the line from Brentford to Hounslow, which was originally opened in 1901. After allowing for that appropriation there remained a balance of £8,142, of which £6,250 had been distributed in payment of a dividend at the rate of 4 per cent. on the preference shares last July. The traffic receipts, amounting to £916,000, showed a decrease of over £11,700; the car mileage run was some 410,000 miles less than the previous year, and the receipts per car mile showed a decrease of .08d. In the first seven months of the year the passenger receipts were £2,243 in excess of those for the corresponding period, and the receipts per car mile showed an increase of .17d. At the end of the year, however, that increase in receipts had been turned into a decrease of £11,793. At the commencement of August they were compelled to reduce their services very considerably owing to the number of motormen and conductors who were called up as Reservists. Over 24 per cent. of the staff were now serving with the Army or Navy. In addition, a considerable number had since the war enlisted in the new forces, and, although new men had been taken on, they were still considerably below their normal number. Originally they had 835 motormen and conductors; now they only had 668. Apart from the reduced services, the receipts decreased owing to the earlier closing of the public-houses and the decreased street lighting. He said last year that he thought their affairs had touched bottom, and their traffics for the first half of 1914 showed that but for the war the year would have compared favourably with 1913. Unfortunately, the working expenses in 1914 did not decrease in proportion to the car mileage. With the exception of the item of running expenses, the working expenses remained more or less constant, although the car mileage had considerably decreased. The company had joined in the T.O.T. Mutual Aid Fund for the purpose of giving help to the dependents of those of the staff who had joined the Colours. They had done what they could to encourage increased traffic by issuing cheap fares for children, and they had obtained powers to run trailer cars and carry passengers in excess of the authorised number at times when there was a rush of traffic.

Lord Knutsford seconded the motion and the report was adopted.

Metropolitan Electric Tramways, Ltd.

Mr. E. Garcke presided on Friday last week over the annual meeting, held at Electrical Federation Offices, Kingsway. The Chairman said that in the early part of last year they had reason to hope that the results of the year's working would be materially better than was shown by the accounts. Up to the 1st of August the traffic receipts were £7,000 greater than those for the corresponding period of 1913, and the receipts per car mile showed an increase of .22d. By the end of 1914, however, this increase in the receipts had been turned into a decrease of £8,500. At the commencement of August the company was compelled to reduce the services very considerably, owing to the number of motormen and conductors who, as Reservists, were recalled to the Colours, and 25 per cent. of the total staff were now serving with the Army and Navy. Apart from the reduced services, the receipts decreased owing to the earlier closing of shops, and because of the restricted street lighting. There was now but little traffic after about 10 o'clock at night in the districts served by the company's tramways. Unfortunately, the working expenses did not decrease in direct proportion to the reduction of the receipts, for, with the exception of the expenditure on electrical power and on wages account, the item of working expenses remained more or less constant irrespective of the car mileage, and even the wages bill had not been reduced in proportion to the reduced services, because during the past year they conceded the men an increase in the rate of pay. A matter of some interest to the public in connection with the traffic arrangements of the company was the extension of through services between the tramways operated by the company and the tramways of the London County Council. Since September last through services of cars had been operated between Barnet and Euston and Moorgate Street *via* the Archway Road. Passengers on the Barnet line could also now book through to Charing Cross from North Finchley *via* the Highgate Tube Railway. At Stamford Hill the company and the L.C.C. had agreed to issue 1d. transfer tickets between each other's systems. Through booking arrangements were also about to be established at Golders Green between the company's Finchley Road line and the Hampstead Tube Railway as far as Charing Cross, and at Scrubbs Lane between the company's line from Harlesden and the L.C.C. tramways as far as Hammersmith. Cheap tickets were now issued to children under fourteen years of age on week-days between the hours of 8.30 a.m. and 5.30 p.m. It afforded the directors much satisfaction to be able to give the public these improved travelling facilities, although that company did not derive much pecuniary benefit from them. The accounts did not call for much explanation. They had expended on capital account during the year £13,269. They had had to increase the suspense account by about £2,000 in respect of interest and expenses in connection with the Watford and Bushey undertaking, which had not been proceeded with, because they decided that the district could be better serve by omnibuses. They had increased the reconstruction and renewals fund investment by about £30,000, and a full list of the investments in which the fund of £138,893 was invested was now appended to the report. It was very nearly eleven years since the first of their lines was opened for electrical working. During that period they had built up large reserves for the purpose of providing for the renewal of the lines, as they were worn out, and it was a very satisfactory feature that the lines had all been maintained in excellent condition, so far, almost entirely out of revenue, and that the large fund which they had accumulated was available to meet any abnormally heavy expenditure on track renewals which might be necessary in future. About 95 per cent. of the whole of the share capital of this company was now held by the London and Suburban Traction Co., Ltd., and only about 8 per cent. of the preference and about 2 per cent. of the ordinary shares were in the hands of other shareholders. The policy of the company was, therefore, now directed by the board of the London and Suburban Traction Co., Ltd. On former occasions he had explained that since the control of this company had passed over to the London and Suburban Co. efforts had been made to minimise the competition between the omnibuses and the tramways, and considerable progress had been made in that direction, but a complete elimination of competition was not possible, and they could not hope to do more than establish such co-ordinated working arrangements as would secure to each company its fair share of the combined revenues, and further negotiations were proceeding with a view to adjusting the divergent interests on that basis. The company and the staff contributed to a fund formed by the allied London traction undertakings for the purpose of assisting the dependents of those employés who had joined the Colours, and he asked the shareholders to sanction the contributions which the company was making to that and other war relief funds.

Mr. C. G. Tegetmeier seconded the motion, which was carried.

South Metropolitan Electric Tramways and Lighting Co., Ltd.

The annual meeting was held on Friday last at Electrical Federation Offices, Kingsway. Mr. C. G. Tegetmeier, who presided, said that the working account of the traction section showed a balance of £22,385, or an increase of £1,112. The traffic receipts from the tramways were adversely affected by war conditions, and in place of a very considerable increase which was indicated during the first seven months of the year there was a decrease at the end of £374. On the other hand, the net profit on the working of their motor 'buses was £1,352 more, owing to their having had the benefit of their running for the whole of the year, instead of for only five months during the previous year. The electricity supply section of the business was still more adversely affected by the war conditions than the traction section. Although there was an increase of 271 in the number of consumers connected, which was a larger increase than they had ever had previously in any one year, the revenue from the sale of current to private consumers was only £654 more than in the preceding year. That comparatively small increase was attributable solely to the restrictions upon lighting imposed by the authorities since the outbreak of war, and the fact that they were able to show even a small increase under the conditions that had prevailed must be regarded as satisfactory evidence of the progressive character of the business. With a return to normal conditions there could be little doubt as to its continuous and profitable development. The capital expenditure during the year amounted to £4,960, practically the whole of which was spent upon the lighting undertaking, £3,947 being expended on the extension of the mains. Expenditure of that nature became necessary as the districts comprised within their large area of supply became settled, and it was likely to be increasingly remunerative. The net profit for the year, after setting aside £3,000 to the renewals fund, the same as in the previous year, amounted to £15,966. With the amount brought forward they had £16,721 available for distribution. They proposed to place £4,500 to the reserve fund, to pay a dividend on the 6 per cent. preference shares in respect of the year 1913, and an instalment of 1 per cent. in respect of the year 1914. That would leave £351 to be carried forward. 30 per cent. of the company's staff—in fact nearly the whole of those eligible—had joined the Forces, and the whole of the present staff were contributing to the fund which had been organised by the companies with whom they were associated, for the assistance of the dependents of those of their employés who had enlisted. The companies themselves subscribed an equal amount to that contributed by the men.

Mr. E. Garcke seconded the resolution, which was carried unanimously.

Guildford Electricity Supply Co., Ltd.

During 1914 the company made satisfactory progress, the gross receipts being £12,356, showing an increased revenue of £571. There was a balance on the revenue account of £3,947 (after crediting depreciation fund account with £1,000) as compared with £4,044 for 1913. After making provision for debenture interest, dividend on preference shares, etc., and placing £250 to the credit of reserve fund account, they had £1,149 available for distribution, out of which they recommended the payment of a dividend at the rate of 5 per cent., less tax, on the ordinary shares, absorbing £760, thereby leaving £390 to be carried forward.

Year.	Connections.	Total Revenue.	Total Costs.	Gross Profit.
1912	969	£10,069	£5,114	£4,955
1913	1,090	£11,786	£6,492	£5,294
1914	1,195	£12,356	£7,409	£4,947

This company, in common with most companies of a like nature, has suffered during the latter portion of last year by the diminution in the sale of electricity, and also in the increased cost of production of same, in consequence of the war. Mr. J. A. C. Younger resigned his position as a director of the company in September, and Mr. E. E. Pullman, who had previously acted as a director, was elected to the vacancy.

	1914.	1913.
Units sold—Lighting	389,811	370,125
Power and Heating	696,660	672,475
Totals	1,086,471	1,042,600
H.P. of Motors Connected	899	810
Total Number of Connections	1,195	1,090

South London Electric Supply Corporation, Ltd.

The annual meeting was held on March 23rd, at the Cannon Street Hotel, E.C. Mr. J. Atherton, who presided, said that during the first half of the year excellent results had been obtained in respect to additional lamps connected, revenue obtained, and gross profit earned. The increase in units sold was 431,567, or 16½ per cent. for the half-year, and they had every reason to hope that this rate of progress would have been continued in the second half-year, but the outbreak of war had the immediate effect of reducing their output, which, however, was gradually recovering to normal in September, when in the latter part of that month the regulations in respect to the disuse of outside lighting were put into force, thus instantaneously forcing down their output for lighting purposes. They had especially felt this, as the shopping districts in their area of supply depended largely upon electricity for outside illumination. These restrictions still remained in force, but, notwithstanding, the total units sold during the year amounted to 6,153,241, and showed an increase over the previous year of 412,015, or 7.2 per cent. for the full year. The extended use of electricity for power purposes had largely contributed to this satisfactory result, for during the year 98 motors of 933 h.p. had been connected to the mains, making a total of 6,304 h.p. on consumers' premises. Further, the additional connections amounted to 1,355 kw., or the equivalent of 38,742 35-watt lamps, and nearly 10,000 in excess of any previous year. This constituted a record for any one year since the commencement of their operations. The gross revenue had increased by £3,385, and the working costs from £23,475 to £25,431. The profit had thus increased £1,429, which was satisfactory, as the period under review included five months of war; and notwithstanding increased costs for labour, coal, and in fact for all commodities used in their business, the total cost per unit sold worked out at the satisfactory figure of .99d. per unit sold, as compared with .98d. in 1913. The capital expenditure during the year amounted to £11,487, of which £1,081 was for buildings, machinery and plant; £1,331 for coal elevating and mechanical stoker plant; mains £5,382, and transformers and meters £1,946, and on special items, including construction of show-rooms and for plant on hire, etc., £1,493 net, after writing off £978 for depreciation. They were satisfied that the expenditure incurred on the show-rooms would well repay them. After referring to the withdrawal of the London electric supply Bills, the Chairman said that at the last meeting they took powers to create £50,000 new capital, divided into 10,000 6 per cent. cumulative preference shares of £5 each, and of these 6,000 were offered for subscription to the existing shareholders and debenture stockholders of the company and were fully subscribed. In view of the momentous events which had taken place since the date of issue, he thought they might congratulate themselves upon having made the issue when they did, thus providing the company with funds so that it might actively prosecute its business. During the latter part of the year they co-opted as directors Mr. J. B. Braithwaite and Mr. H. B. Renwick, of the County of London Electric Supply Co., Ltd., that company having acquired a considerable financial interest in the company with a view to their closer relationship and for mutual assistance, their areas of supply being contiguous. They were fortunate in securing the assistance of these two gentlemen, whose presence on the board would add considerable strength to the directorate. They had had unrivalled experience in dealing with electric supply problems, particularly in connection with the development of electric supply in London, and this should prove of great benefit to the company, not only in developing their own business, but also in dealing with the broader question of the London electric supply problem and the many troublesome and complicated points arising from it. About 25 per cent. of their normal establishment having joined the Colours, this representing nearly 50 per cent. of the eligible men in the company's employ, a point had now been reached making it inadvisable for any more employés to leave the company's service for the Colours, as the principal departments would then become under-manned, a condition of affairs which would be serious in view of the public service which was being given, and of the fact that a large number of factories in Lambeth were working directly or indirectly on Government work and depended almost wholly upon their supply for driving their machinery and lighting their premises. Much as they congratulated those men who had left to serve their King and country, it must not be forgotten that those who were compelled to remain behind on this public work and its maintenance carried serious responsibility, much of which could only be entrusted to specially-trained men possessing the necessary skill and experience. They were making money allowances to all those who had enlisted, and although this would be a heavy burden, the board felt sure they would think it only right that their dependents and others should be well looked after in the breadwinner's absence; and to those men who were still in the company's service, war bonuses on a graduated scale were being given to assist them in the extra cost of living. There had been, and were still, many difficulties to contend with in the proper maintenance of their supply, and coal bulked largely. At times there had been serious difficulty in obtaining adequate supplies, principally owing to congestion on the railways due to the movement of troops and military stores, and to the great shortage of railway wagons, and to the lessened output from the collieries owing to so many of the miners having enlisted. They were having to pay considerably in excess of their contract prices for some of their coal, and although they raised their charge for supply to some of their consumers early last year, it might again be necessary to further increase the rates to compensate them for the considerably greater expenses to which they were committed under the prevailing conditions. The available balance was sufficient to pay a dividend of 5½ per cent. on the ordinary shares, as in 1913, and still leave sufficient to pay a further 1 per cent. on the ordinary share capital, but having regard to the unknown conditions through which they might have to pass during the present year, they considered that the interests of all concerned would be better served by paying a dividend of 5 per cent. for the past year, which would enable them to strengthen their cash resources by carrying forward £2,898, against £727, thus making it possible, if circumstances were favourable, to initiate the payment of interim dividends on the ordinary shares.

Mr. A. Madge (a shareholder) seconded the motion, which was adopted without discussion.

British Insulated and Helsby Cables, Ltd.

Dr. E. K. Muspratt presided at the annual meeting, held at Liverpool, on March 22nd. He said the profit for 1914 was £277,428, an increase of £30,077. The results were very satisfactory considering that the profits were greater than the company had made in any previous year, and that for about half the year the working had been under war conditions. The extra profits were not due to orders for war supplies. Work had been done both for the War Office and the Admiralty, but the total was not large enough to materially affect the earnings as a whole. The war had affected business with many of the company's best customers, such as municipal corporations and large electric light and power companies, who had ordered less than they would have done in normal times. On the other hand, the company had done a much larger business than before the war with neutral countries. No consignment of manufactures on the prohibited list had been despatched to any neutral country without the knowledge and consent of the British Government or without care to prevent them reaching an alien enemy. The general result had been that the company's factories had been very busy throughout the whole of the year, and the unexecuted orders in hand at the present time were more than ever before. A considerable number of the company's staff had joined the forces, and both they and their dependents had been liberally dealt with by the board. The staff and workpeople had also on their part, by voluntary weekly subscription, contributed to relief funds to the extent of over £1,000. The company was now paying a war bonus to its employés to meet the enhanced cost of living. Having regard to the good results of the year's trading the directors had felt justified in setting aside £25,000 towards the formation of a pension fund, which had been under consideration for several years past. They felt they could hardly expect to retain in their service the very best men without some such provision, and they felt that the formation of such a fund was in the best interests of the company and the shareholders, and that in making it they were following the example of the Government and many large and successful companies. The extinguishing of the item of patents and goodwill had much strengthened the balance sheet. Alluding to the investments of the company, the Chairman said they now stood at £531,423, as compared with £525,828 in the previous year; a valuation of the investments had been made, with the result that the figure came out at some thousands more than the

amount appearing in the balance sheet. The two companies, namely, the Midland Electric Corporation for Power Distribution, Ltd., and the Electric Supply Co. of Victoria, Ltd., in which the British Insulated held considerable interests, were making satisfactory progress, and the Automatic Telephone Mfg. Co., Ltd., in which the British Insulated also had a large shareholding, was now for the first time paying a dividend of 3 per cent. on its ordinary shares, the profits having risen from £24,166 to £38,263, an increase of £14,097. The cash resources of the British Insulated Co. now amounted to no less a sum than £270,862, and the directors considered, especially under present war conditions, that this strengthened the position of the company very much indeed and brought many contracts which it would otherwise be impossible to deal with. One such contract at present in hand was for the Australian Government, amounting to about £600,000.

The report was adopted.

Automatic Telephone Manufacturing Co., Ltd.

At the third annual meeting, held in Liverpool on March 22nd, Mr. James Taylor (Chairman) said the profit for the year amounted to £38,248, an increase of £14,081, which indicated satisfactory progress. In recommending a 3 per cent. dividend they felt that in present times, if able to pay a small dividend they should do so, as investors had so many calls on their incomes, which were already in many cases reduced. There had been a substantial increase in the company's turnover during the year, and this increase was chiefly due to the fact that a good start had been made in executing the orders for automatic exchanges referred to in his report of last year. The present position of the automatic section of the business was as follows:—The four exchanges at Epsom, the General Post Office, Simla in India, and Cordoba in Argentina, continued to work well, and to the satisfaction of the purchasers. The traffic on these exchanges had increased at a greater rate than was usual with exchanges worked on the manual system, and in consequence extensions of the plant had already been called for. The exchange at Rosario referred to last year had been completed, and was working satisfactorily. Quite recently the automatic exchange at Accrington had successfully been brought into service. The company had also in hand exchanges for Leeds, Newport, Blackburn, Chepstow, Paisley and Portsmouth, on all of which good progress had been made, and all of which the company was prepared to complete this year, but some delay might arise in bringing them into use on account of circumstances beyond the control of the company. From the reports of those working, both here and abroad, they felt every confidence in the future of automatic telephones. During the year the company had continued to receive assistance from the Automatic Electric Co. of Chicago, but it was satisfactory to know that they were now able to manufacture in this country all except a small percentage of the equipment of an automatic exchange. The general business of the company during the year in ordinary telephone and telegraph instruments had been satisfactory, and at considerable inconvenience they had undertaken work for the Admiralty and the War Office.

The report was adopted.

Madras Electric Tramways (1904), Ltd.

The annual meeting was held on March 23rd at Dashwood House, E.C., Mr. A. M. Quill presiding.

In proposing the adoption of the report, the Chairman said the accounts for 1914 showed a balance from running account of £21,356 as compared with £20,975, an increase of £381, or, say, 1¾ per cent. The gross receipts amounted to Rs. 6,66,633, compared with Rs. 6,44,201 in 1913. An increase of 8.7 per cent. was shown for the first seven months of 1914, but after war was declared business in Madras suffered in common with that of all other places, and during the last five months of the year the traffic receipts steadily fell. The increase for the whole year, therefore, was only 3.5 per cent. They were still suffering from the depression, the receipts this year to the middle of March being 2.2 per cent. less than the corresponding period of 1914, but perhaps they had reason to be thankful that things were no worse. The number of passengers carried in 1914 was 17,622,219, an increase of 5.22 per cent. The cost of running had shown an increase, due chiefly to repairs rendered necessary by the monsoon (which was unusually severe last year), and the net increase from running was accordingly only 1¾ per cent. At the last meeting he informed them that Government had suggested a scheme of road widening in Chintadripet, which would have enabled another line of rails to be laid in that district. As these negotiations had been proceeding for some years the board decided that Mr. Gray should visit Madras and endeavour to effect a settlement, because until a diversion of the line was made it was impossible to proceed with any extensions, or, indeed, to develop the existing lines further. As neither the Corporation of Madras nor the company could contribute towards the cost of street widening, another route had to be considered, and the diversion which they had all along advocated, viz., along Mount Road, over Government House Bridge and along Body Guard Road to the Central Station, had now been sanctioned by the Corporation. This route would necessitate the widening of Government House Bridge and Penitentiary Bridge, and plans had been submitted for the approval of Government. He trusted that these would be passed without undue delay and so permit the development of the undertaking to proceed. A scheme for providing accommodation for the natives in the suburbs of Madras was now being considered by Government and the Corporation, and he was glad to say that the routes for extensions which they themselves had in contemplation coincided in a large measure with those recommended by the authorities, but the distance which these extensions were to be carried would require further consideration. Meantime, they had indicated their willingness to proceed with the extensions gradually as soon as the diversion along Mount Road had been completed. The arrangements made for the joint management of the Madras Electric Supply Corporation, Ltd., and this company had proved satisfactory, and would effect savings in the management of both companies. He thought it right to mention that the company had a contingent liability in respect of a bank loan to the Madras Electric Supply Corporation, Ltd.

Mr. James Gray, in seconding the motion, referred to his recent visit to Madras, and said he fully concurred in the opinion of the company's representatives there that the diversion of the lines should be *via* Mount Road and Body Guard Road, as that was the direct route between the northern and the southern parts of the city. The new route would constitute, really, a trunk line, enabling them to provide a more rapid through service, and it would also permit of extensions to various parts of the city which they did not at present touch. Speaking generally, he was pleased with the condition of the undertaking. The permanent way, with the exception of two small sections, had now been laid with 90-lb. rails, which were in very good condition. The buildings were of a substantial character and the workshops were equipped with all the tools necessary for building tramcar bodies and for executing repairs to the rolling stock. A petition was presented to him praying for an increase in the rates of wages and the creation of a provident fund. As a regular system of advancement was already in operation, it was not necessary to grant the former, but the creation of a contributory provident fund would, he thought, be a good thing for the company and the matter was now under the consideration of the board.

The report was adopted.

A French Investment Co.

The report for 1914 of the Société Centrale pour l'Industrie Electrique, of Paris, whose board includes representatives of various large banks in Paris and leading experts in the electrical industry, records on a paid-up capital of £800,000 net profits of £43,000, which sum has been placed to a special reserve fund in consequence of the effects of the war, whilst the balance of £5,200 from 1913 has again been carried forward. It appears that the war effects were perceptible in the working of the Compagnie Centrale d'Energiè Electrique in Algiers, Oran, Rouen and Chateauroux, and a reaction is apprehended in the receipts of the Société des Tramways et Electricité, of Constantinople. The capital increase of the Compagnies Réunies Gazet Electricité, of Lisbon, was carried out, and the year 1913-14 yielded a dividend of 7½ per cent., as in 1912-13. The report refers hopefully to the capacity of development of this particular company. In addition, a further example—the Société Force Electrique, of Baku—paid for 1913 a dividend of 9 per cent. on the preference shares and 6 per cent. on the ordinary capital, and although working in 1914 was interrupted owing to a lengthy strike movement, the gross profits materially increased. It is added that despite the situation of war, the petroleum industry in the region of Baku seems to be in full activity.

Italian Supply Companies.

Notwithstanding the mobilisation of the Italian Armies which has been proceeding for several months past, the course of the war has not detrimentally affected any of the supply companies if we may judge from the accounts which have so far been published for 1914, although when we speak of Italian supply concerns it has to be remembered that various German and Swiss companies hold large interests in many of them, and these may be mentioned in parenthesis. The Società Adriatica di Elettricità (Zurich Bank for Electrical Enterprises), of Venice, for instance, has decided to pay 7 per cent. for 1914 on capital of £800,000, as compared with the same rate on less capital in 1913; the Società Idroelettrica Ligure, of Milan (Zurich Bank), 8 per cent. on £360,000, as against the same rate in 1913 on less capital; the Società per le Forze Idrauliche dell' Alto Po, of Milan (Zurich Bank), 8½ per cent. on £184,000, as contrasted with 8 per cent; the Società Elettrica Riviera di Ponente Ing. R. Negri, of Milan (Zurich Bank and Swiss Electrical Industry Co.), 6 per cent., as in 1913, on £800,000; and the Società Lombarda per Distribuziona di Energia Elettrica, of Milan, 9 per cent. on £750,000, as compared with 10 per cent., the reduction being due to the necessity for writing down paper securities. In addition to these instances the German Schuckert group controls five subsidiary companies in Italy, four of which are

distributing the same rates for 1914 as for the preceding year. These are the Società Sicula per Imprese Elettriche, of Palermo, 8 per cent. on capital of £320,000; the Società Toscana per Imprese Elettriche, of Florence, 10 per cent. on £400,000; the Società Bergomasca per Distribuzione di Energia Elettrica, of Bergamo, 4 per cent. on £161,000; and the Società Torinese di Tramways e Ferrovie Economiche, of Turin, 5 per cent. on £240,000. On the other hand, the fifth company—the Società Industriale Elettro-chimica di Pont St. Martin—has been compelled to refrain from paying any dividend for 1914, this result comparing with 5 per cent. on £140,000 in 1913. The explanation is to be found in the fact that the company's Bard power station was put out of service last July in consequence of damages caused by high water, and it was only possible to proceed with repair works on low-water conditions which prevailed in February of the current year. The examples given show the fair degree of prosperity which applies to a number of supply works in Italy, but they by no means exhaust the list of undertakings, including manufacturing, in which foreign capital is largely interested, and which have greatly contributed towards the industrial development of Italy.

British Aluminium Co., Ltd.

Mr. A. W. Tait (Chairman) presided on Friday, at Winchester House, E.C., over the annual meeting. He said that trading profit and other income for the year was £272,256, as compared with £268,720, or an increase of £3,535. These results showed some slight improvement over the previous year, which up to that time was the best result obtained since the company was originally incorporated in the year 1894. In last year's report, and in his remarks at the annual meeting, he mentioned that, although the results were good, no progress could be made in an absolutely straight line, and, in March last, in common with other industries, there was a temporary set-back in the demand. This set-back continued for several months, but about the middle of the year there was a gradual improvement in the position. The prospects were, however, considerably upset on the outbreak of the war. When this occurred, there was naturally a period of considerable anxiety, because the company sold its production practically all over the world, and a large portion of that production had usually been sold in Germany, which had been the largest user of aluminium in Europe. The war, therefore, involved the cancellation of a considerable number of orders and contracts which were upon the company's books; but he was pleased to say that, so far as the year under review was concerned, this had been offset by the increased demand of the British Government and its Allies and contractors working for them. The result of the year had, therefore, been that the output and sales showed an increase over the previous year, and the prices realised were approximately on the same level as the previous year. The costs of production were, however, affected—specially in the closing months of the year—by the increased prices of certain materials, freight, insurance, and other expenses. He thought, therefore, considering the slackness in the demand at the beginning of the year and the abnormal conditions suddenly created by the war, the results were on the whole satisfactory. With regard to the demand for aluminium, this, in their opinion, still continued to increase, although it was a little difficult to forecast what the position would be after the war. There was, however, ample scope for development in the various uses of the metal. At the present time, there was a good demand for the metal for war material, equipment and stores; but how far this exceptional and unusual demand would be taken up by general commercial development afterwards it was somewhat difficult to forecast. There was every reason to believe, however, that as regarded the year 1915 the company would be able to market the larger part, if not the whole, of its production at reasonable prices. The question of the company's production for the current year was dependent very largely on two factors, viz., (1) labour, (2) ability to obtain and maintain the necessary stocks of raw material and coal. Owing to the splendid response which had been made by the young men of this country to the call for service to the Empire, and owing to the Government call on the labour that remained being a paramount one, it was extremely difficult for other employers of labour to maintain adequate forces. So far as their company was concerned, the response to the country's call had been extraordinarily good. The number of members of the staff and employés who had joined the Colours was about 550, which was approximately 22 per cent. of their total forces. Two of their directors were serving also, namely, Captain Pollen and Captain Cooper. In accordance with the general custom which had been adopted by the various manufacturers in this country, they had made provision for the dependents of the members of their staff and the families of their employés who had joined the forces. Their industry, which was very largely a specialised one, required a considerable period of training on the part of the men before they were able to give efficient labour, and, for some time past, it had been increasingly difficult to supply the gradual wastage which had occurred due to causes which he had mentioned. They were employing a certain number of Belgians, but the supply of those who were capable and willing to work was very far below the demand of the labour market at the present time. Their staff and men, however, had been working in an excellent way, and had responded exceedingly well to the additional strain put upon them, and they hoped that they might be able to keep the whole of their works going during the year nearly up to their full capacity. With regard to the second difficulty, namely, that of obtaining and maintaining the necessary supplies of raw material and coal at the various works, their chief difficulty was with regard to their principal raw material—bauxite. This was obtained from their mines and from stocks in the South of France. Immediately after the outbreak of war, the French Government declared bauxite contraband and placed an absolute bar upon its exportation. They were able, however, with the help of the Foreign Office, to convince the French Government of the absolute necessity for this raw material to enable the company to supply Government contracts, and a special permit was given for export, although it was still necessary to obtain a special permit for each cargo, which very often involved delay and demurrage. Apart from that, it was becoming increasingly difficult to obtain the necessary freighting facilities to their works. In order that the shareholders might appreciate to what extent this disturbance and increase in prices affected the company's costs of production, he might mention that, in the course of a year, they had to deal with approximately 200,000 tons of seaborne freight. The market for coal had also been affected, and there was also a heavy burden in connection with insurance to cover marine and war risks on raw materials and metal. It was not possible in any considerable measure to raise the price of the metal to compensate for these increases in expenditure, as a large quantity was contracted for before these troubles became manifest, and it had also been the desire to prevent any great fluctuation in prices in order to protect and encourage the users of the metal. In a business of this magnitude, a certain amount of capital expenditure must always be going on. The preliminary work for the erection of the new alumina works at Burntisland was in progress, but, owing to difficulties in obtaining labour and material, it was not expected that these works could be in operation until next year. The power plant required for the rolling mills at Warrington had been completed, and these mills were now operating satisfactorily to their full capacity. The final balance of the purchase price for the acquisition of the works at Vigelands, Norway, from the Anglo-Norwegian Aluminium Co., was completed in June last. This purchase was an advantageous one for the company, and had largely increased their productive capacity. The acquisition of those works necessitated the increases in their carbon-electrode works at Kinlochleven and the erection of the new alumina works at Burntisland in order to supply adequately their increased requirements of those materials. They hoped and expected that the whole programme would be completed in the course of next year, and, as all the capital necessary for the acquisition of those works and for the extensions at other works which he had mentioned, together with the necessary working capital for their operation, had been found out of the resources of the company, the shareholders were to be congratulated on the increased capacity which had been obtained without the necessity of an increase in capital, and they would agree that the building up of reserves, which had been the policy of the board since the incorporation of the new company, had been more than justified. The company's rolling mills at Milton and Warrington had been kept employed up to their full capacity during the year, and the demand for manufactured aluminium continued to grow in a satisfactory manner. With regard to their interests in Switzerland, there had been no change since the position was last reported. The Martigny-Orsières Railway continued in operation for general traffic, and the Orsières power scheme was being properly maintained and supervised, but no new work was being carried out. In the balance sheet the stocks of metal, raw materials and stores, amounted to £187,266, or an increase of, approximately, £14,000, as compared with the previous year. This increase was largely to be accounted for by the increase in the working stocks at their various factories. Sundry debtors and bills receivable stood at £119,561, as compared with £91,400, or an increase of approximately £28,000. This amount was after making provision for all bad and doubtful debts, and in this connection he might mention that all debts due by parties in Germany, which he was pleased to say were not of very large amount at the outbreak of the war, had been written down to a nominal sum. Cash in hand and at bankers stood at £163,308, as compared with £140,092, or an increase of approximately £23,200 over the previous year. It was necessary for a company of their magnitude to keep a large cash reserve, and more particularly so in the present times. The allocations to reserve account for the last two years, amounting to £100,000, had not been invested in securities outside the company's business owing to the necessity of making provision for capital expenditure. The dividend recommended by the board on the ordinary share capital was at the same rate as the previous year, and, in view of the difficulties which he had mentioned, the board considered it was prudent that the dividend on the ordinary shares of the company should not be increased. They felt that in these somewhat uncertain and difficult times the interests of the shareholders would be best served by maintaining the dividend on the ordinary share capital for the year 1914 at the same rate as the previous year. It was evident from Press cuttings that there had been an idea in the minds of several persons that the company had benefited largely by the war, but this was not the case. In the minds of others, there seemed to be an extraordinary

ignorance of the company's manufactures, because in one paper it was quoted with all seriousness that the company was doing extraordinarily well, working night and day for the Government in the manufacture of aeroplane engines. The company were producers of aluminium in crude and manufactured form, but they did not undertake complicated questions of mechanical engineering such as those which had been attributed to them.

Mr. J. Taylor seconded the motion.

Mr. C. Hacking asked what were the prospects of the company recovering its trade with Germany after the war?

The Chairman said that Germany had been the largest users of aluminium in Europe, and it was difficult to forecast what would happen. Germany manufactured a very small amount of aluminium and must come into the markets of the world to purchase. He did not anticipate that there would be the slightest difficulty in doing trade with Germany if they desired to do it.

The motion was carried, as was also a resolution of thanks to the board and staff.

Marconi's Wireless Telegraph Co., Ltd.

The directors have declared a dividend of 7 per cent., less income tax, upon the 250,000 7 per cent. cum. participating pref. shares in respect of the year 1914, payable on April 19th. In making this announcement the directors say that the company has continued since the outbreak of war in full control of its business, but its stations have been largely devoted to Government work. For this reason the new direct public service with New York, which it had been contemplated would have been opened in the summer of last year, has had to be postponed. In other respects the company's business has been necessarily disturbed, and considerable business which was pending in many foreign countries has been delayed or deferred. This, however, has been substantially compensated for by Government and other business directly resulting from the war; the works and all the company's staff have been working under the highest pressure throughout the whole period. A number of matters, including the question of compensation and payment for services, being still in abeyance, the directors are as yet unable to estimate with sufficient reliability the results of the business of last year to warrant them at this moment in declaring an interim dividend upon the ordinary shares. They are, however, of opinion that there is no reason for deferring the dividend upon the preference shares. The directors say that they contemplated being in a position to give shareholders information with regard to other matters of importance concerning the company's business, but as these still remain under negotiation, it has been resolved not to delay further this announcement and the payment of the dividend.

STOCKS AND SHARES.

Tuesday Evening.

At this season of the year, the coming of the Easter Holidays always necessitates earlier preparation of matter, as well as advertisements, for the Electrical Review, and this is the reason why the financial section has to be made up earlier than usual. The approach of Easter in the ordinary way is a signal for Stock Exchange business to slack off, but in this year of surprises it is not so astonishing to find that the House is developing a good deal of activity. Possibly this may be because most people are compelled, for one reason or another, to curtail their Easter holidays. Some are too busy to go away; others are too idle. The position may be illustrated by the traditional Stock Exchange complaint that when members are making a lot of money, they have no time to spend it; and when they have plenty of time to spend money, it means that they are not making any. The withdrawal of the usual railway facilities, which presses so hardly upon thousands of the workers in the Metropolis, offers another excuse for staying in town by those to whom a holiday flight to golfing grounds or the seaside has been in previous years a matter of course.

As was foreshadowed here last week, the price of electricity is to be put up; and this will come as no surprise to those who have any acquaintance with the conditions under which concerns connected with the industry, or with gas, are labouring at the present time. When gas companies raise the price of their product they are obliged to lower their dividends. Electric lighting companies, however, are not confined by any such sliding scale as that which operates in the case of the gas companies; but it would be too much to expect that the former will maintain their dividends if the raising of the price of current has any pronounced effect upon consumption. These are, however, too early days to discuss the matter with any degree of certainty; and it is mentioned merely as a hint to shareholders that they may be called upon to make some further sacrifice, in addition to whatever disabilities they have already suffered in consequence of the war.

The leading article in last week's issue dealt with the serious aspect presented to many electricity undertakers through the Treasury limitations of capital expenditure. The subject is one closely concerning the companies, as well as local authorities, and it has been already discussed earnestly in certain board-rooms. Fortunately, the charge of extravagance in capital expenditure is one that has been rarely levelled at electricity supply companies—at any rate, within the past half-decade; and this has been due largely to the fact that the continual discussion of schemes for taking over the companies, with a view to the constitution of one central authority for the supply of London as a whole, has been ever-present to the minds of those charged with the control of the business.

So it comes about that the spending departments have lived in an atmosphere of wholesome economy; and that further capital expenditure may be prohibited by the Treasury is a threat which will probably convey less terror to directors in the electrical world than to most other branches of domestic industry. Still, those companies which are well buttressed with reserves have additional cause for congratulation at this time. It is understood in the Stock Exchange—to whose Committee are forwarded copies of applications made by companies for new capital issues—that the Treasury interprets its prohibitory powers with a reasonable amount of elasticity, and that, where definite cause of national interest can be shown, the applicant for permission to raise more money can reckon upon his proposals meeting with at least favourable consideration.

This week a large number of ex-dividend markings have been made, and already in some cases deductions have been recovered, either wholly or in part. County ordinary, for instance, at 11⅜ have regained the full amount of the dividend. South Londons are up to 3 xd. The fall in Westminsters has been checked, the price recovering ¼ to 7½. Cities at 14¼ are ex their dividend, and in several of the leading shares this re-arrangement of prices has resulted in investment purchases.

The rumour linking the South London and the South Metropolitan Companies with the County of London Electric Supply Co. has gained ground since we referred to it—with intentional vagueness. On the face of it, there is a good deal to make one hesitate about accepting it as even probable; and so we mention it for what it may be worth. South Metropolitan ordinary shares have been wanted just lately, some people having given as much as 11s., although a month or so ago the nominal quotation was about half as much as this. South Londons have been a good market for some time past; therefore it can scarcely be inferred from their present strength that developments must have taken place quite recently to account for the way in which the shares have been sought after.

We append our usual list of representative stocks and shares in the markets connected with electricity:—

	Mean price. July 27, 1914.	March 27, 1915.	Rise or fall this week.
Home Electricity Companies.			
Brompton Ordinary	9⅜	8¼ xd	– ⅛
do. 7 per cent. Pref.	8⅝	7⅝ xd	– ⅛
Charing Cross Ordinary	5¼	4¾	–
do. do. do. 4½ Pref.	4⅝	4⅝	–
do. do. City Pref.	4⅜	4	–
do. 4 Deb.	91½	90	–
Chelsea	4⅞	4⅝ xd	–
do. 4½ Deb.	96½	92	–
City of London	16	14¼ xd	–
do. do. 6 per cent. Pref.	13⅛	12⅛ xd	–
do. do. 5 Deb.	116½	112	–
do. do. 4½ Deb.	100½	98	–
County of London	12	11⅝ xd	+ ⅛
do. do. 6 per cent. Pref.	12	11¼ xd	+ 1/16
do. do. 1st Deb.	102½	100	+1
do. do. 2nd Deb.	100½	97	–
Kensington Ordinary	7⅛	7	–
London Electric	1 7/16	1⅜	+ 1/16
do. do. 6 per cent. Pref.	5 7/16	4⅝	–
do. do. 4 Deb.	92½	87	–
Metropolitan	8⅜	8 xd	–
do. 4½ per cent. Pref.	4 7/16	4	–
do. 4½ Deb.	97½	96	–
do. 3½ Deb.	83	80	–
St. James' and Pall Mall	9⅜	8½	+ ⅛
do. do. do. 7 per cent. Pref.	7	6⅝	–
do. do. do. 3½ Deb.	84½	80	–
South London	2 1/16	2 xd	+ 1/16
South Metropolitan Pref.	1⅛	1⅛	–
Westminster Ordinary	8⅜	7½	+ ⅛
do. 4½ Pref.	5⅜	4⅝	+ ⅛
Telegraphs and Telephones.			
Anglo-Am. Tel. Pf.	108½	108½	–
do. Def.	23	21⅝	+ ⅛
Chile Telephone	7⅜	6⅜	–
Cuba Sub. Ord.	8½	8½	–
do. Pf.	16½	15	–
Eastern Extension	12⅜	12⅜	–
do. 4 Deb.	97½	92	–
Eastern Tel. Ord.	130½	131	+2½
do. 3½ Pf.	77⅜	78⅛	– ⅛
do. 4 Deb.	96½	93	–1
Globe Tel. and T. Ord.	11½	11	–
do. Pf.	12⅞	12	+ ⅛
Gt. Northern Tel.	32⅜	29	–
Indo-European	59	51	–
Marconi	1 15/16	1⅞	– 1/16
New York Tel. 4½	101	98	+1
Oriental Telephone Ord.	2 5/16	2	–
do. Pf.	1 7/16	1⅜	–
Tel. Egypt Deb.	98	88½	–
United R. Plate Tel.	6⅜	6	–
do. Pf.	5½	5	–
West India and Pan.	1½	1 7/16	– 1/16
Western Telegraph	13⅝	13	–
do. 4 Deb.	96½	93	–1
Home Rails.			
Central London, Ord. Assented	83	76½	+ ½
Metropolitan	37½	29	–1
do. District	21¼	17½	– ½
Underground Electric Ordinary	2¼	1⅞	– 1/16
do. "A"	7/8	5/8	– 6d.
Income	88	81 xd	–

	Mean price. July 27, 1914.	March 27, 1915.	Rise or fall this week.
Foreign Trams, &c.			
Anglo-Arg. Trams, First Pf.	4⅞	4½	—
do. 2nd Pf.	4¼	3⅞	—
do. 4 Deb.	91	84	—
do. 4½ Deb.	98½	91	—1
do. 5 Deb.	96	88	—
Brazil Tractions	66	59½	— ½
Bombay Electric Pf.	11⅝	10⅝	—
do. 4½ Deb.	96	91	—
Mexico Trams	70	80	—5
do. 5 per cent. Bonds	84	45	—
do. 6 per cent. Bonds	76	30	—
Adelaide Sup. 6 per cent. Pf.	5½	5½	+ ⅛
do. 5 Deb.	104	103	—
Manufacturing Companies.			
British Westinghouse Pref.	1⅝	2	+ ½
do. 4 Deb.	74½	72	—
do. 6 p. lien	102½	99	—
Callenders	11½	12	+ ½
do. 5 Pref.	5½	4⅞	—
do. 4½ Deb.	98½	98	—
Castner-Kellner	2½	3⅛	—
Edison & Swan, £3 pd.	3/32	14/6	—
do. do. fully paid	1½	2⅛	— ⅛
do. do. 4 Deb.	59	63	—2
do. do. 5 % Deb.	68½	60	—
Electric Construction	1/64	18/9	+3d.
do. do. Pf.	1/32	1	—
Gen. Elec. Pf.	10½	10	—
Henleys	15	14⅜	+ ⅛
do. 4½ Pref.	5	4¼	— ⅛
do. 4½ Deb.	100½	97	—
India-Rubber	9	9	+ ½
Telegraph Con.	38½	37	— ⅛

Marconi shares have gone back a little to 35s. sellers—not because the company has just lost an action for damages in which a comparatively small sum was involved, but because the directors announce that they cannot declare an interim dividend upon the ordinary shares at the moment. A number of matters, they say, including the question of compensation and payment for services being still in abeyance, they are as yet unable to estimate with sufficient reliability the results of the business of last year, but they are of opinion that there is no reason for deferring the dividend upon the preference shares. Matters of importance concerning the company's business are still under negotiation, but the directors state that some of the disturbance caused by the war has been sufficiently compensated; and they add that the works and all the company's staff have been working under the highest pressure throughout the whole period covered by the war. The preference are steady at 33s., and, in the subsidiaries, small falls lowered American Marconis to 9s. 3d., and Canadians to 5s. 3d.

The outstanding feature in the telegraph market is the strength of Easterns, the stock having risen 2¼ to 131½, thus passing its end-July, 1914, level. "China" shares now stand the same as they did at that time, and Easterns at 13¼ are but 7s. 6d. lower. The market shows decided strength, but, oddly enough, a few of the prior-charge stocks are on offer, for which the reason probably must be sought in the fact that new gilt-edged issues are being made at prices so tempting that they encourage holders of existing stocks to sell these, and to apply for the newcomers.

Mexico Trams are 5 points lower. Brazil Tractions, on a decline in the Rio rate of exchange to 13 7/32d., continued to droop. The Anglo-Argentine Tramways division is fairly steady, and likely to improve, since the suspicion with which most Argentine things have been regarded is now wearing off; and the railway market especially exhibits new signs of vitality.

Callenders, Henleys, and India-Rubber shares are all better. British Insulateds have hardened to 11, ex the dividend of 11s. Electric Constructions rose a few pence. Telegraph Constructions are 10s. easier, heavy shares such as these being vulnerable to the offering of any small amount. Edison and Swan have eased off a little, and the first debenture is 2 points lower at 63. Armament shares rallied a little, and the rubber market is one of the best in the Stock Exchange. Renewed attention has been called to the excellent position of most of the well-managed concerns; and since proprietors are in no mood for selling, the demand which has sprung up from investors has had a bracing effect upon the market, although at the same time it has been difficult to satisfy.

Midland Electric Corporation for Power Distribution, Ltd.—The report states that the revenue was adversely affected during the first two months of the war, but, apart from the supply of energy for light, has since improved. The balance to the credit of the net revenue account, after payment of debenture interest, is £17 859, plus £3 572 brought forward, making £21,431, of which the directors have appropriated to depreciation of plant and machinery, £8 582; depreciation of stores, £500; writing off of commission and expenses of issues of debentures and shares, and expenses during construction, £4 275; payment of a dividend of 6 per cent. on 13,079 preference shares, £3,923; transfer to a debenture premium redemption account, £500; carrying forward £3 651.—*Financier.*

Lancashire Dynamo and Motor Co., Ltd. The *Times* states that the ordinary share dividend is 8 per cent. for the year, free of tax.

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Monday, March 29th.

CHEMICALS, &c.		Latest Price.	Fortnight's inc. or Dec.
a Acid, Hydrochloric	per cwt.	4/6	..
a ,, Nitric	,,	19/-	..
a ,, Oxalic	per lb.	10½d.	..
a ,, Sulphuric	per cwt.	5/-	..
a Ammoniac Sal	,,	£49	..
a Ammonia, Muriate (large crystal)	per ton	£49	..
a Bleaching powder	,,	£9	..
a Bisulphide of Carbon	,,	£21	..
a Borax	,,	£20	..
a Copper Sulphate	,,	£28 10	..
a Lead, Nitrate	,,	£35	..
a ,, White Sugar	,,	..	..
a ,, Peroxide	,,	..	..
e Methylated Spirit	per gal.	6d.	..
a Potassium, Bichromate, in casks	per lb.	..	..
a Potash, Caustic (88/90 %)	per ton	£75 to £80	..
a ,, Chlorate	per lb.	1/6	..
a ,, Perchlorate	,,	1/6	..
a Potassium, Cyanide (98/100 %) (for mining purposes only)	,,	Nom.	..
a Shellac	per cwt.	65/-	..
a Sulphate of Magnesia	per ton	£5 10	..
a Sulphur, Sublimed Flowers	,,	£11 10	..
a ,, Recovered	,,	£8	..
a ,, Lump	,,	£8 10	..
a Soda, Caustic (white 70/73 %)	,,	£10 2 6	..
a ,, Chlorate	per lb.	9½d.	..
a ,, Crystals	per ton	45/-	..
a Sodium Bichromate, casks	per lb.	5¾d.	..
METALS, &c.			
Aluminium Ingots, in ton lots	per ton	£90	..
,, Wire, in ton lots (1 to 14 S.W.G.)	,,	£120	..
b ,, Sheet, in ton lots	,,	£150	..
p Babbitt's metal ingots	,,	£50 to £221	..
c Brass (rolled metal 2" to 12" basis)	per lb.	9½d.	½d. inc.
c ,, Tube (brazed)	,,	11d.	½d. inc.
c ,, ,, (solid drawn)	,,	10½d.	½d. inc.
c ,, Wire, basis	,,	10d.	½d. inc.
c Copper Tubes (brazed)	,,	1/-	½d. inc.
c ,, ,, (solid drawn)	,,	1/-	½d. inc.
g ,, Bars (best selected)	per ton	£90	£4 inc.
g ,, Sheet	,,	£90	£4 inc.
g ,, Rod	,,	£90	£4 inc.
d ,, (Electrolytic) Bars	,,	£77	£6 inc.
d ,, ,, Sheets	,,	£95	£6 inc.
d ,, ,, Rods	,,	£83	£6 inc.
d ,, ,, H.C. Wire	per lb.	10½d.	½d. inc.
f Ebonite Rod	,,	8/-	..
f ,, Sheet	,,	2/6	..
n German Silver Wire	,,	1 8	..
h Gutta-percha, fine	,,	6/10	..
b India-rubber, Para fine	,,	2/5½	..
l Iron Pig (Cleveland warrants)	per ton	68/7	2/7 inc.
l ,, Wire, galv. No. 8, P.O. qual.	,,	£18	..
g Lead, English Pig	,,	£24	..
m Manganin Wire No. 28	per lb.	..	..
g Mercury	per bot.	£12 5 to £12 10	..
c Mica (in original cases) small	per lb.	4d. to 2/6	..
e ,, ,, ,, medium	,,	3/- to 5/	..
e ,, ,, ,, large	,,	6/6 to 10/6 & up.	..
o Nickel, sheet, wire, &c.	,,	Nom.	..
p Phosphor Bronze, plain castings	,,	1/1 to 1/3½	..
p ,, ,, rolled bars & rods	,,	1/2 to 1/3½	..
p ,, ,, rolled strip & sheet	,,	1/3½ to 1/6½	..
e Platinum	per oz.	125/-	..
d Silicium Bronze Wire	per lb.	10½d.	..
r Steel, Magnet, in bars	per ton	£70	..
g Tin, Block (English)	,,	£174	..
n ,, Wire, Nos. 1 to 16	per lb.	2/6	..
p White Anti-friction Metals	per ton	£52 to £194	..
k Zinc, Sh't (Vieille Montagne bnd.)	,,	Nom.	..

Quotations supplied by—

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakspeare.
h Edward Till & Co.
l Bolling & Lowe.
k Morris Ashby, Ltd.
l Richard Johnson & Nephew, Ltd.
m W. T. Glover & Co., Ltd.
n P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p
r W. F. Dennis & Co.

P. R. Jackson & Co., Ltd.—The *Financial Times* states that for 1914 the gross profit was £13,475, and after payment of interest on debentures, depreciation, &c., there is a balance of £8 948. The directors recommend a dividend of 6 per cent. on the ordinary shares, writing off goodwill account £2,000 and leaving to be carried forward £1,756.

Winnipeg Electric Railway Co.—For 1914 the net earnings amounted to $1,685,093, and after providing for fixed charges and four quarterly dividends of 3 per cent. each, a credit to profit and loss of $901,697 brought forward was reduced to $816,309. A dividend of 2½ per cent. has been declared for the quarter ending March 31st.—*Financial Times.*

Huelva Gas and Electricity Co., Ltd.—The net report for 1914 was £2 051, plus £245 brought forward. Deducting the dividend on the preference shares, the directors recommend that £1,400 be written off for depreciation of gas and electric plant, leaving £574 to be carried forward.

ELECTRICITY IN MINES.

[The Report of H.M. Electrical Inspector of Mines.]

The report for the year 1913 of Mr. Nelson, H.M. Electrical Inspector of Mines, is included in the General Report of the Chief Inspector of Mines, which has just recently been issued.

The report deals first with the growth of the use of electricity in mines, the following being a summary of the returns received on January 21st, 1913 :—

	Surface H.P.	Underground H.P.	Total H.P.
Scotland	26 279	93,361	119,640
Northern	64 837	79,422	144,259
York. and North Midland ..	55,954	51,245	104,200
Lancashire, North Wales and Ireland	9,884	20,863	30,747
South Wales	90,581	91,237	181,818
Midland and Southern ...	9,141	35,294	44 434
Totals ...	256,676	371,422	628,098
Total for year 1912 ...	194,088½	316,667½	510,756

These figures show an increase of 32·24 per cent. in the electrical H.P. installed for the surface ; 17·29 for underground ; and a net total increase of 22·97, which is very satisfactory indeed on a year's working.

A further estimate of the growth of the use of electricity in the different divisions may be made by comparing the number of tons of mineral raised per electrical horse-power employed with the corresponding figure for the year 1912, as shown in the following table : —

Division.	Tons of mineral raised in 1913.	Tons of mineral per electrical H.P. employed. On surface.	Below ground.	Above and below ground together 1913.	Corresponding figure for 1912.
Scotland	47 434,287	1,805	508	395	449
Northern	65,263,291	1,007	822	452	538
York. & North Midland	73,449,759	1 314	1,434	686	744
Lancashire and North Wales	28,480,739	2,881	1,365	926	1,028
South Wales	57,009,050	629	625	314	336
Midland and Southern	29,924,227	3,274	848	673	718
United Kingdom...	301,611,353	1,175	812	480	534

In regard to coal-cutting, the number of electrically-driven machines in 1913 was 1,307, being an increase of 173 over the number in use at the end of 1912.

Fatal Accidents.

There were during the year 1913 15 fatal accidents definitely due to electricity, and causing in all 16 deaths. In addition, a serious fire at the Big Pit of the Blaenavon Iron and Steel Co., at Blaenavon, Monmouth, on April 7th, which resulted ultimately in the loss of three lives, was held by most investigators to have been due to the failure of an electric cable, and the disaster at Senghenydd Colliery on October 14th was held by the Commissioner appointed to investigate the cause to have been possibly, but not certainly, due to sparks from electric signalling wires. The two latter accidents apart, the figures for the year 1912, comparable with those given above for 1913, were 12 accidents causing 14 deaths. In 1913 there was therefore an increase of three accidents and two deaths over the figures for 1912.

The whole of the 15 accidents which occurred in 1913 were electric-shock accidents. Of these, three took place on the surface and 12 below ground. The two classes of accident will be separately considered, so that any conclusions it may be possible to draw shall have application to surface conditions and to underground conditions respectively. The figure for electric-shock accidents below ground, which had begun to show a downward tendency, has risen again, as will be seen below :—

	1907	1908	1909	1910	1911	1912	1913
Number of persons killed by electric shock below ground in coal mines ...	10	12	13	15	9	7	13

The figure for 1913 is disappointing in comparison with 1912, although the horse-power of electric plant in use below ground increased by 17 per cent. during the year.

For the first time it is possible, from the data available, to determine the rate of increase of the horse-power of electric plant in use below ground. On the assumption that that rate of increase is normal, and not exceptional (and there is no reason to think that it is other than normal), the horse-power of electric plant in use below ground has increased by 95 per cent. since the end of the year 1909, whereas the number of persons killed by electric shock, as will be seen, was the same in 1909 as in 1913. It is also of interest to note that of the 79 persons killed by electric shock below ground, in seven years between January 1st, 1907, and January 1st, 1914, 45 were killed in the first half of that period, and 34 in the second half ; figures which, taken in conjunction with the increase of electrical horse-power in the second half period over the first half period, seem to show that the risk of fatal electric shock below ground is decidedly a diminishing risk. It is, on the other hand, unsatisfactory to note that of the 12 fatal electric-shock accidents that occurred below ground in 1913 (one of the accidents was responsible for the deaths of two persons), at least *nine might have been avoided by greater care in the maintenance of apparatus and stricter regard to the regulations.*

Surface Accidents.—Of the three electric-shock accidents, one occurred on a high-pressure alternating-current system, one on a medium-pressure alternating-current system, and one on a low-pressure alternating-current system. In the case first mentioned the victim of the accident touched some part of the winding of a three-phase motor supplied with current at 3,000 volts. Though the insulation appeared externally to be perfect, it was, in fact, insufficient, and a fatal electric shock followed. The accident on a medium-pressure system was of an unusual character. A derrick-pole was being erected by means of steel wire guy ropes, when one of the latter made contact with an unprotected fuse in the neighbourhood belonging to a 5-H.P. motor supplied with three-phase current at 400 volts. The ground was wet, and the man who had hold of the guy rope that made contact with the fuse was killed. The fuse which caused the accident should clearly have been protected. The accident on the low-pressure system was the result of an act by the victim himself (a boy of 13), and his death may fairly be classed as a misadventure. The evidence given at the inquest showed that the boy who was killed challenged one of his mates to climb a railing, and from this position to touch some electric wires which would then be within his reach. His mate refused, so the victim himself climbed the railing and touched the wires. He was killed instantly, though the pressure was not high (220 volts alternating).

Underground Accidents.—Out of the 12 underground electric shock accidents, nine occurred on medium-pressure three-phase alternating-current systems, two on medium-pressure continuous-current systems, and one on a low-pressure two-phase alternating-current system. The circumstances of each of these accidents have been considered, with the result given by the following table :—

Due to :—	*Accidents.*	*Deaths.*
1. Faults as regards the earthing of metallic outer coverings of apparatus :—		
(*a*) Total absence of any connection to earth	1	1
(*b*) Break in continuity of earth connection	2	3
(*c*) Outer covering earthed but connection with earth inefficient	3	3
2. Contact, direct or indirect, with live parts of cables :—		
(*a*) Direct contact with a live cable exposed through abrasion of the insulation ...	3	3
(*b*) Contact with a conductor (a girder) made live by its contact with a live cable exposed through abrasion of the insulation	1	1
3. Accidental contact with uninsulated live parts of apparatus	2	2
	12	13

The above table may be summarised thus :—

	Accidents.	*Deaths.*
1. Contact with outer coverings of apparatus live through the absence of, or an inefficient, earth connection	6	7
2. Defective insulation of cable systems ...	4	4
3. Contact with uninsulated live parts ...	2	2
	12	13

For the period between January 1st, 1905, and December 31st, 1913, that is to say, in nine years, electric shock below

ground has been responsible for 83 recorded accidents and 86 deaths. Mr. Nelson has carefully considered the available information in regard to all of these accidents (a large portion were personally investigated by him), and they may, he thinks, justly be analysed as follows :—

	Accidents.	*Deaths.*
1. Contact with outer coverings of apparatus live through the absence of an efficient earth connection	37	40
2. Defective insulation of cable systems ...	32	32
3. Contact with insulated live parts	12	12
4. Other causes (misadventure)	2	2
	83	86

Defective earthing has, therefore, been responsible for very nearly 50 per cent. of the deaths due to electric shock below ground. Imperfect insulation of cables has been responsible for 37 per cent. of such deaths.

Summary of Fatal Electric Shock Accidents in 1913.

	Accidents.	*Deaths.*
Surface Accidents :—		
(*a*) On three-phase systems :—		
Low pressure	1	1
Medium pressure	1	1
High pressure	1	1
(*b*) On continuous-current systems :—		
Low pressure	—	—
Medium pressure	—	—
Underground Accidents :—		
(*a*) On three-phase systems :—		
Low pressure	1	1
Medium pressure	9	10
High pressure	—	—
(*b*) On continuous-current systems :—		
Low pressure	—	—
Medium pressure	2	2
	15	16

Of the accidents on the three-phase systems, 13 in all, 10 were on completely insulated systems and 3 on systems with the neutral point connected to earth.

Of the 16 persons killed by electric shock in 1913, 3 were coal-cutter attendants, 2 were surface labourers, 2 were underground road repairers, 2 were motor attendants, 1 was a haulage hand, 1 a pony driver, 1 a foreman, 1 a coal conveyor attendant, 1 a drawer, 1 a surface screen boy, and 1 a trained electrician.

Non-Fatal Accidents.

During the year 1913, 53 separate non-fatal accidents, or dangerous occurrences, were reported. There were no non-fatal ignitions of firedamp reported as having been due to electricity, as against 1 in 1912. There were, however, 3 underground fires as against 2, and 50 electric shock accidents causing injury to 51 persons, against 36 accidents causing injury to 36 persons in 1912. All the electric-shock accidents were in mines under the Coal Mines Act, as also were all the underground fires.

Underground Fires Caused by Electricity.—Three underground fires were reported as having been due definitely to electricity in 1913.

The first occurred on January 16th at Leven Colliery, Fife, Scotland. It was caused by the breakdown of two cables which were carried through the woodwork of a trap-door, and in contact therewith without effective insulation, and without armouring. The fire burnt for about an hour, and the woodwork of the door and some props were destroyed. No one was injured.

The second fire occurred in a haulage motor house at the Duffryn Rhondda Colliery, Port Talbot, South Wales, on March 11th. In order to shield the motor-man from the cold intake-air, a piece of brattice cloth was hung behind him, and in the neighbourhood of the cables running from the motor-controller to the resistances. The fire was caused by a short circuit in the base of the controller, which set fire to the cables referred to. The fire travelled *via* their outer coverings to the brattice cloth, which, in turn, caught fire, and some of the neighbouring props were scorched, but help was close at hand and the fire was quickly extinguished.

The last was the least serious of the three. It occurred in a pump room at Markham Colliery, Hollybush, near Newport, Mon., on May 2nd. A short-circuit due to a breakdown of insulation at a cable dividing box caused an arc, which ignited the rubber insulation of some neighbouring cables. The fire spread to a rubber mat on the floor of the pump room, but it was readily extinguished by the application of a little sand.

Electric Shock Accidents.—Of the 50 electric shock accidents causing injury to 51 persons which were reported during 1913, 30, causing injury to 30 persons, took place below ground, and 20, causing injury to 21 persons, took place at the surface. Of the 51 persons injured, 43 were disabled for more than seven days. In three cases the victim was unconscious for some time, artificial respiration being successfully applied in each case. In four other cases the victims were very seriously injured by burns.

The first of these four cases occurred in the generating station at the surface of Silverwood Colliery, Rotherham, Yorkshire, on February 9th. Two men were working behind a live 500-volt alternating-current switchboard, when one of them dropped a spanner across some live parts. The short-circuit caused an arc, which badly burned both men about the head and face. It is said that the men were working with current on, in disobedience to instructions.

The second of the accidents above referred to occurred in the generating station at Littleburn Colliery, Durham, on May 29th. The victim, a contractor's foreman, was explaining to a member of his firm how he intended to fix some conductors which were about to be erected behind the switchboard. He had a pair of pliers in his hand, and with these he made accidental contact with some live metal. The shock caused him to fall against three bare conductors carrying 2,750-volt alternating current. He was very seriously burnt, losing his left arm. After the accident the bare conductors were effectively protected.

The third accident occurred at Greenrigg Colliery, Fauldhouse, Linlithgow, Scotland, on August 19th, and resulted in severe burns to the victim's left arm and hand due to the failure of the insulation of a trailing cable which he was handling. The system in this case was continuous current and the pressure 500 volts.

The fourth accident occurred at Bargoed Colliery, Monmouthshire, on December 29th. In this case the victim was a switchboard attendant, and he committed the error of attempting to examine a switch which was live at the time, and which he knew to be live. He short-circuited the conductors in the neighbourhood of the switch, which was carrying 3,300-volt alternating current, and was badly burnt on the left hand, face, and neck as a result.

Unclassified Non-Fatal Accidents.—An accident of an unusual character occurred at the Prince of Wales (Haigh Moor) Colliery, near Pontefract, Yorkshire, on August 25th. The glass forming the peephole on a coal-cutter frame was blown out with such force that it caused incised wounds in the back of the attendant, who was at the time 10 yards from his machine. As the result of investigation and experiment it was agreed that there had been an explosion in the coal-cutter frame caused by the volatilisation of some insulating varnish, unduly heated by a short circuit in the motor armature. This short circuit also ignited the gas which formed inside the frame of the coal-cutter, and which proved to be explosive.

The chief point to be noticed in the report is the importance of having an efficient earth, and as we have on several occasions pointed out, shortcoming in this respect, in our opinion, is due not so much to neglect on the part of the management as to incompetence of the electricians in charge. It is sometimes difficult to get a really efficient "earth" in a mine, and unless the electrician in charge has a little more knowledge than a merely practical one, it is very possible he does not clearly understand how to obtain, much less maintain, an "efficient earth" as defined in the Special Rules regulating the use of electricity in mines.

It is also a little disconcerting to have three fires reported due to electricity, and shows how much care is necessary in installing and maintaining electrical cable and plant in mines. If the colliery company cannot afford the services of a really competent engineer, then at least it would pay them to have a monthly or quarterly report made by an outside engineer. Accidents are expensive, and prevention is much better than cure.

REVIEWS.

Samuel F. B. Morse: His Letters and Journals. Two volumes. By E. L. Morse. London: Constable and Co. Price 31s. 6d. net.

In these two volumes, which are written by his son for the purpose of giving to the world "through characteristic letters and contemporary opinions an accurate portrait of the man and a succinct history of his life and labours," we have the story of Morse the artist and inventor. With the "artist" part of the biography we do not propose to concern ourselves here, interesting though it be, and teeming with material that enables us to appreciate the man from many different aspects. Here we shall confine ourselves to the period beginning with the dinner-table conversation on board the s.s. *Sully* in 1832, and terminating with Morse's death 40 years later—a period of stress and trial, of buoyant hopes and crushing disappointments, ending at last in success and world-wide celebrity.

During the dinner-table conversation just alluded to the subject of electromagnetism was discussed, and Morse rose from the table with the idea that there was "no reason why intelligence might not be transmitted instantaneously by electricity," quite ignorant of the fact that the same thought had occurred to the minds of others long before his day.

That Morse first conceived the idea, or was the inventor, of the telegraph, no one to-day who knows anything of the subject would seriously maintain. The distinction of having first published the idea of applying electricity to the telegraph belongs to the historic Scotsman, "C. M.," who enunciated his views in the Scot's Magazine in 1753, and the invention attained its practical realisation in the hands of Le Sage, of Geneva, in 1774. Hence the need for the reader to guard himself against the acceptance of such expressions as "the inventor of the telegraph," which are sprinkled freely throughout the book in reference to Morse.

In our desire to do justice to Morse we must not allow ourselves to forget the work of those who had laboured at the problem before him, as well as those who were contemporary with him.

Forty-two years after the invention of Le Sage, and 16 years before Morse embarked on the *Sully*, our own countryman, Ronalds, of Hammersmith, had telegraphed over eight miles of wire, with such success that he presumed to suggest its adoption by the British Admiralty for coast communication purposes, only to meet with a refusal on the ground that the existing system of telegraphing (semaphore) was sufficient for their purpose.

In 1820 Ampère constructed a telegraph, using a magnetic needle, wires and a battery; in 1828 Dyer erected a telegraph line on poles, with glass insulators, on Long Island, New York, and produced signals on prepared paper by means of electricity, and in 1830, in Dublin, Booth showed how electromagnetism could be used to telegraph to a distance and cause marks to be made by the fall of the armature of a magnet when the current was broken. Now these were all antecedent to the year 1832, when Morse claimed to have had his inspiration. They not only embodied the idea of a telegraph, but actually were practical methods of telegraphing, although crude ones. Morse's ignorance of what had already been done—an ignorance admitted by his biographer—need hardly be wondered at when we find two Judges, who tried one of the cases in which he was involved, giving it as their opinion that "Mr. Morse was the first to devise and practise the art of recording language at telegraphic distances by the dynamic force of the electromagnet, *or, indeed, by any agency whatever*" (the italics are ours).

That Morse did not continue in this state of ignorance is shown by the following significant interrogatories and answers, which appear in the records of a litigation with Bain, the inventor of the electrochemical recorder:—

"Nineteenth interrogatory. Do you mean to say that you were the first to discover that when an electromagnet is connected with, and forms a part of, such circuit the magnet becomes attractive and non-attractive, as the current flows or ceases to flow? Answer: I do not.

"Twentieth. Do you mean to say that you were the first inventor of the combining an electromagnet and an armature in a circuit of electric or galvanic conductors? Answer: No, not generally in the abstract; but I do claim to be the first inventor of combining an electromagnet and an armature, *as described in my letters patent*, and of combining this combination with a circuit of electric or galvanic conductors."

So much for Morse being the inventor of *the* telegraph. Let us now see if he can lay claim to having invented the first practical telegraph. In the year 1837 his apparatus, on his own admission, was in such an unfinished state that he was unwilling for it to be seen. In the same year Cooke and Wheatstone, in England, patented the first practical (needle) telegraph—practical in the sense of being a commercial undertaking. On June 10th, 1840, the first American patent for an electric telegraph was granted to these two inventors, and ten days *later*, on the 20th of the same month, Morse was granted his *first* patent for "a new and useful *improvement* in the mode of communicating information by signals by the application of electromagnetism."

These facts speak for themselves, and need no comment.

Again, in order to show that Morse was not ignorant of electrical principles when he conceived the idea of a telegraph, it is contended by his biographer that he (Morse) "was familiar with much that had been discovered with regard to that mysterious force (electricity) through his studies under Profs. Day and Silliman, of Yale, and through the lectures and conversations of Profs. Dana and Renwick in New York, so that the charge which was brought against him that he knew absolutely nothing of the subject, can be dismissed as proving the ignorance of his critics" (vol. 2, page 3). In a deposition made in March, 1850, Prof. Henry (the man after whom we name our practical unit of inductance) said of Morse:—"He appeared to be an unassuming and prepossessing gentleman with very little knowledge of the general principles of electricity, magnetism, or electromagnetism, &c."; and again, in giving evidence in the Bain case already referred to, the same high authority stated:—"I am not aware that Mr. Morse has ever made a single original discovery in electricity, magnetism, or electromagnetism applicable to the invention of the telegraph. I have considered his merit to consist in combining and applying the discoveries of others *in the invention of a particular instrument* and process for telegraphic purposes."

When reading through these pages, if we are to prevent our judgment from becoming obscured by the admiration which this fine tribute of a son to the memory of his father evokes within us, we must bear the facts in mind; for there is much, apart from the vexed question of priority, that we should like to dwell upon in this story of a man who voluntarily relinquished a remunerative profession, in which he had attained to a place of high distinction, to tread the rough and thorny path of the inventor, wherein he was to suffer penury and want, obloquy and insult, and be looked upon as an eccentric and a visionary.

We do not admit his claims, which in this book are reaffirmed, because in the truer perspective, with which the lapse of years has furnished us, we are enabled to estimate his position and work more dispassionately and impartially than was possible for his contemporaries; but in doing so, we recognise his right to a conspicuous place amongst the many workers who have contributed to the progress of electromagnetic telegraphy.

Much has been achieved since the days of Morse; and the advent of fast-speed printing telegraphs and multiplex telegraphs is threatening to displace whatever remains of the more modern form of his recorder in the shape of the Wheatstone receiver. But when we contemplate the long evolutionary process which has resulted in the marvellous systems at our disposal to-day, and try to single out any one name as that of the "inventor of the telegraph," we the more consciously recognise the truth of Sabine's remark that the arrogance of any individual claim to the title cannot be recognised; and those men who deserve the most credit happen to be those who advance the least claim to it.* —A. F.

* "Telegraph History and Progress," by Robert Sabine, C.E.

Dynamo and Electric Motor Building. By A. H. Avery. London : Cassell & Co., Ltd. Price 1s. net.

In this volume the author has done justice to his long experience in the art of building small dynamo-electric machines, by providing at a purely nominal price a fully illustrated and thoroughly practical treatment of the alternative constructions available, and the materials and methods of construction and assembly best suited to the needs of the amateur with limited resources. Chapter I presents a simple and clear explanation of the fundamental principles of dynamo-electric current generation, and is followed by an equally clear explanation of the function of the commutator, the effect of brush width, angular lead, and auxiliary poles. The author is to be complimented on dealing with these topics without introducing theoretical matter so tempting to the expert and so confusing to the amateur ; the explanations given are clear, simple, and quite concordant with the practical nature of the work.

The general requirements and materials of field magnets are outlined in Chapter III, and the relative merits of different types of field systems are discussed briefly. The desirability of laminating armature cores is explained in the next chapter and the practical merits of different forms of stampings are discussed ; means for ventilating the core might be described a little more fully and the use of wedging strips instead of binding wires deserves mention. In dealing with commutator construction the author becomes rather general in his remarks ; more definite and practical information is here required by amateurs. Brushes and brush gear are dealt with in considerable detail ; the relative merits of various brush materials and the reasons for and applicability of different mounting methods are discussed, but here again a little more definite practical information might be included. Next follow three chapters on insulation and windings to which the author rightly attaches great importance, for defects in the material or arrangement of field and armature windings are responsible for most troubles in home-built machines. The instructions and illustrations here presented are admirable and should meet all requirements. Both hand and former wound armature coils are considered.

Chapter IX presents full working instructions for the building of a 120-watt motor-dynamo converter, it being assumed that the reader buys the main castings ready made. The principle of working of the converter is first explained, then follow detailed and fully-illustrated instructions as to the sequence and manner in which machining and erecting are to be performed. This chapter is beyond criticism, and the notes concerning commutator and brush gear construction rectify the slight deficiencies noted in the chapters relating specifically to these topics. Chapter X includes general notes, and outline working instructions for the building of a number of small dynamos and motors, besides giving more detailed treatment of the construction of a 1-H.P. motor. The working drawings are clear and to scale, and include only essential dimensions. Suitable winding quantities and speeds are merely stated, and one wonders whether a simple explanation could not be given of means of calculating, at least approximately, the relation between winding, size and weight, horse-power and speed. The average amateur is, perforce, content to adopt instructions given by the makers of the castings, or advised in the query columns of journals devoted to model building ; or else to depend on chance. If he could be shown how to design his windings, the interest and value of building and testing the machine would be much increased.

A few tables showing the weight of various sizes of wire accommodated in various spaces, the number of laminations of various thicknesses per inch, and so on, would be a valuable addition. Chapter XI, dealing with motor-starters, is cursory ; the author explains how to calculate the total starting resistance, but then recommends that it be divided into equal sections ; personally, we should not consider this advisable in a 2-H.P. starter, and, in any case, the advantage and method of proper grading should be explained. The final chapter on testing dynamos and motors for faults is thoroughly good. The book is well indexed, well produced, and to be recommended as an excellent investment to all readers, whether amateur or professional, interested in building small dynamo-electric machines.

Clock Repairing and Making. By F. J. Garrard. London : Crosby Lockwood & Son. Price 4s. 6d. net.

As a thoroughly practical treatise, of value to the amateur as well as to those in the trade, this book deserves high praise. Difficulties which are likely to be met with in the repair of clocks of various kinds are clearly pointed out, and the methods of overcoming the same are equally clearly explained. The writer is one who has had practical experience of the whole subject he deals with, and the numerous "wrinkles" which are so useful in mechanical work of the kind are freely given. Here and there, however, there are indications that the writer accepts common practices without questioning their correctness. On page 2, for example, he states that the bob of a pendulum is lens-shaped for the purpose of enabling it to cut the air easily. That this is the intention is doubtless true, but that that particular shape actually accomplishes the desired result is, we think, rather doubtful ; probably no one has thought it worth while to question the correctness of the supposition, which, after all, is of negligible importance.

On page 126 the statement is made, in reference to turret clocks, that "steel lines if put on wooden barrels cut the wood to pieces." To this statement we can, from practical experience, give an unqualified denial, for the lines merely dig slightly into the wood and form a spiral groove ; such a practice is, it is true, not one to be recommended, but it certainly is not a disastrous one.

In regard to the dissertation on page 3 in reference to "Pallets and Crutch," it is much to be desired that the most unsatisfactory arrangement of providing practically no adjustment for setting the pallets in the position to give a correct beat has not been got rid of ; a few better-class clocks have two adjusting screws (page 149), but in the great majority of cases the crutch (of springy wire) has either to be bent by means of a pair of pliers, or the pallets twisted round on their axle, to which they are secured spring tight, or rather spring loose, in many cases. Again, anything more absurd than the way in which clock cases are made it is difficult to imagine ; they seem to be designed with the express purpose of making it impossible to get at any part of the works for cleaning or adjustment. Clock makers or clock repairers seem to have resigned themselves to the stereotyped designs, or rather want of design, and in explaining how to take a clock apart and put it together again, point out difficulties which will be met with, but do not state that these difficulties arise from absurdities in the construction of the clocks. Mr. Garrard treats of clocks as they are, and anyone reading through Chapter II, which deals with "cleaning a skeleton clock," cannot but be struck with the completeness with which he treats the subject. Chapter III, on "Clock repairing," is full of useful information. In Chapter IV, in referring to "drills," Mr. Garrard states that "a drill is not a difficult thing to make," but such information as he gives as to how this is to be accomplished is most incomplete, and anyone desiring definite information is hardly likely to be satisfied with being told that the drill "may then be filed up to the correct shape," no information whatever being given as to what thiss hape shall be. The statement on page 127 that turret clocks should be "boxed in free from damp" is entirely wrong ; what is wanted is the freest possible circulation of air through louvres, and no "boxing in" ; this was pointed out by Lord Grimthorpe many years ago. We are pleased to note that Mr. Garrard considers that electric clocks have a large future before them, though he does not go into the subject at any length, this being beyond the scope of the book. In spite of the occasional incompleteness of information, the work, as a whole, is one strongly to be recommended to all those who are interested in clock making and repairing ; it may be studied with very great profit, especially by country clockmakers, whose knowledge of their trade is, in a multitude of cases, deplorably incomplete, to say the least.—H. R. K.

Dinner.—The employés in the switch works of Messrs. Ferranti, Ltd., of Hollinwood, have just held their first annual dinner at the Star Hotel, Failsworth. Mr. Torrance, works manager, presided.

ELECTRICITY APPLIED TO MINING.

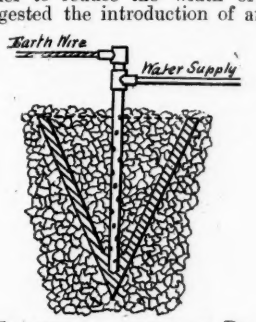
[*The following discussions took place on the paper read by* Mr. C. P. Sparks *before the* Institution of Electrical Engineers; *see page* 454.]

Discussion at Newcastle.

Mr. J. Leggat said that even where local collieries had their own generating plant it very frequently paid them to arrange for a stand-by supply from the local supply companies, and they were thus able to dispose of surplus energy if they produced any. He assumed that the Ilgner sets were installed on account of the comparatively small size of the generating plant, and that had the generating plant been of much larger capacity, ordinary induction motors would have been used, either coupled direct to the winding drums or geared.

Dr. W. M. Thornton said that he noticed that the disposal of the small coal was given as the reason for installing gas engines, and he would be glad to know if the "Bettington" boiler had been considered, as this was giving wonderful results elsewhere. He regretted that no costs were given in the paper, as the inclusion of these would have strengthened the case for electrical driving very considerably. He had come across several cases of protective devices acting without any fault being discoverable on the cable, and assumed that faults occasionally sealed themselves up. The duration of such faults was comparable with the duration of surges. For earth plates, he suggested a design consisting of an inverted hollow cone, as shown in the accompanying sketch; if provision were made to run water into this cone it would provide a continuous source of moisture for the surrounding coke. Due attention had not been paid to the effects of the comparatively large inductance of the ordinary mining electric bell. With the amount of inductance due to an electric bell in the circuit, the ordinary currents in use could undoubtedly cause explosions. He did not consider the figures at the end of the paper accurate enough to be put forward as authoritative. There was no doubt whatever that mixtures of pit gas could be ignited when using present-day voltages. With alternating currents, a higher percentage of gas was necessary to obtain the maximum explosive effect. The only way out of the difficulty was to shunt the actual coil of the bell by means of a high non-inductive resistance. This could be added to any bell cheaply, and only increased the ringing current by about 10 per cent.

Mr. W. Baxter said that even if the costs had not been stated in pounds, shillings and pence, it would have been interesting to have comparative figures for the gas and steam stations. In order to reduce the width of single-reduction haulages, he suggested the introduction of an idle wheel between the motor pinion and the spur-wheel on the haulage; this would lengthen the bed-plate somewhat, but would obviate the somewhat unmechanical extension bed-plate for the motor where it had to be placed alongside of the haulage. Turning to the generating plant, he noted that the nine turbo-generators were made by no fewer than four firms, the alternators by four firms, and there were six different combinations of complete sets. Reading between the lines, it appeared that the gas engines had not been much of a success, and he asked why it was that these large gas engines were so successful abroad, and so unsuccessful, as a rule, in this country. He considered that a weak point in the Coal Mines Act, 1911 (General Regulations of July, 1913) was in insisting upon a surface earthplate without at the same time insisting upon earthplates at each level, as it had been shown conclusively by Mr. W. W. Wood that very dangerous conditions might arise with a surface earthplate only, due to insulating strata intervening between the surface and the various levels. Mr. Sparks's recommendation to earth the neutral point in every case was decidedly too sweeping; colliery managers and electricians held that an earthed neutral was not necessarily better than an insulated neutral. It was highly dangerous to make it possible for an automatic protective device to plunge a whole pit into darkness, and where separate lighting cables were installed, to be consistent, these should also have automatic leakage protection, with possibly disastrous results in the event of an earth occurring. With regard to underground lighting, he did not consider that rubber-insulated cables run in screwed tubing made a satisfactory job. He suggested the use of cab tire-sheathed cable for this work. With regard to the cost of running miners' electric lamps, the cost of lamp bulbs averaged 0.12d. per lamp per shift, whereas no lead cell on the market could be run for much less than .3d. per lamp per shift. It was, however, a fact that when using alkaline cells the cost of battery maintenance just equalled the cost of lamp-bulb maintenance.



Method of Earthing suggested by Dr. Thornton.

Mr. H. W. Clothier thought that it was better to eliminate lightning arresters altogether. With regard to the objection that automatic leakage protective devices might cause danger by plunging a pit into darkness, he suggested the use of a number of these devices at different parts of the system, so graded as to cut out the defective part only. He suggested that relays might be used in connection with signalling systems, as these could be made to work with very minute currents; in one case he had in mind the power required did not exceed 0.08 volt-ampere. He did not agree with Dr. Thornton that the figures given at the end of the paper were unsatisfactory, because they formed a faithful record of something which was not known before.

Mr. P. V. Hunter said that in considering the results of a colliery electrification one could generally state whether or not the advice had been good by noting the power factor, and from the excellent results shown in the paper it was apparent that the Powell Duffryn scheme was a well-designed one, with motors properly proportioned for their work. He quite agreed that for the installation under consideration fifty cycles was much better than twenty-five cycles. He joined issue with Mr. Sparks on the question of burying the earth plates at a great depth; a much better arrangement would be to have a multiplicity of earth plates. To provide an efficient earth for static sub-stations it had been found necessary to provide no fewer than eight plates placed 40 ft. apart and carefully bonded together.

Mr. C. P. Sparks, in reply, said that the special ventilating arrangement shown in connection with the Elliot Pit pumping station had been found necessary owing to the high temperatures attained by the atmosphere in the pump-room and to guard against accumulations of coal dust. He took exception to Dr. Thornton's remarks that the tests on ignition by signalling wire were not scientific, as an elaborate series of tests had been very carefully made. The gas engine installation had not been a failure, and the company were increasing the number of gas engines. The variety of types of machinery was accounted for by their trying to eliminate faults discovered in existing plants.

Discussion at Birmingham.

Mr. R. A. Chattock said that it was interesting to find that the gas-driven generators required 18 B.Th.U. per watt-hour against 36.5 for the live steam turbines. This difference was largely accounted for by the difference in the load factor governing each type of generating plant, the gas plant having a load factor of 72 per cent., whilst the steam only had 47 per cent. Even better figures than those given should have been obtained with such load factors. It was certainly very necessary to keep the load factor on the gas-driven plant at the highest possible point, and it was interesting to see that in mining work it was possible to adjust the load by carrying out the pumping during the night time and supplying the general colliery demands during the day, and thus to obtain an annual load factor of 72 per cent. Some years ago he went into the question of using gas plant compared with steam turbines for ordinary electric power supply from a central station, and he was satisfied that an annual load factor of at least 35 per cent. would be required before the gas plant could compete with the steam turbine. The ordinary central station, working on light, power and traction load, had only a load factor of about 25 per cent., and the adoption of gas-driven plant was therefore not justified. These conclusions were based not only on the actual cost of generation by the two methods, but also on the capital cost of the plant and buildings required; in addition, he considered that turbine-driven plant was more reliable than large gas engines, experience with which had not, up to the present, been entirely satisfactory.

Mr. N. Shuttleworth said that the Ilgner motor-generator sets described in the paper were probably the second largest in the Kingdom. As with all other sets of a similar kind, it was necessary to arrange for a considerable drop in speed between no load and full load on the induction motor, so that excessive demands made on the C.C. generators could be provided by the flywheel at the expense of its stored energy. The methods in use for enabling this speed drop to take place as the load increased were as uneconomical as it was possible to imagine. In the present instance a resistance was inserted in the secondary circuit of the induction motor which absorbed at maximum slip or minimum speed some 15 per cent. of the total input to the motor. The average slip in the absence of further particulars might be assumed as 8 per cent., which meant that 8 per cent. of the continuous input to the induction motor was wasted. The liquid slip regulators which consumed this energy required considerable attention and were expensive to keep in good repair. He would suggest the use of a rotary slip regulator, which took the form of a commutator motor inserted in the slip-ring circuit of the induction motor to be regulated. Making allowances for the losses in the rotary regulator, some 7.5 per cent. of the present input to the induction motor would be saved. Moreover, the power factor of the induction motor would be improved at the same time practically to unity, so that on the whole

the supply current would show a reduction of approximately 20 per cent. Incidentally this also improved the efficiency of the system because the colliery plant was fed by transmission lines of considerable length in which the losses inclusive of step-up and step-down transformers would not be less than 7 per cent., and by reducing the line current by 20 per cent. the transmission losses were reduced to 4.5 per cent. The rotary regulator could, therefore, be said to save no less than 10 per cent. of the present input and at the same time increase the carrying capacity of the transmission system. On the basis of cost of power of one penny per ton of coal raised to the surface, the saving for both winders amounted to 6s. per working hour, or probably £5 per day. It would seem, therefore, that the direct benefits to be obtained from the use of a rotary type regulator amply justified further capital expenditure in this direction.

Mr. C. Jones gave particulars of electrical apparatus which he had installed at Cannock Chase Colliery, and emphasised the large field which was open to electrical engineers for electric haulage to perform the work now done by pit ponies.

Dr. C. C. Garrard, in speaking of flame-tight boxes for electrical apparatus, pointed out the advisability of always carrying out the tests with coal gas, as this was a more highly explosive gas than the gas found in mines, and consequently if the boxes were safe with coal gas they could be relied upon to give complete protection in service under mining conditions.

Discussion at Manchester.

Mr. Seaton stated that Lancashire would very shortly possess a thoroughly up-to-date colliery electrically equipped throughout and with steam turbines as prime movers.

Mr. W. T. Anderson said it was remarkable that all fatal accidents in connection with electricity below ground were due, not to unearthed systems, but invariably to high resistance in the earth circuit. It was most difficult to convince colliery managers and engineers of the importance of earthing. Generally speaking, earthing consisted of putting an 18 in. earth plate into the ground, and if a bell rang through it all was considered well. Heavy earth plates buried in made ground were invariably used, and in his opinion were a source of considerable danger. He described a system of earthing adopted at the Clifton and Kearsley coal mines in which cast-iron pipes 9 ft. long by 9 in. diameter, were buried vertically in a pit which was constantly supplied with water. Recent tests showed a resistance of 3.8 ohms between duplicate sets of pipes and 1.48 ohms between pipes and sets in parallel. The 50 per cent. conductivity in metallic sheathing demanded by the Rules was, in his experience, almost impossible with joints. Earthing of neutrals was very necessary.

Mr. G. M. Brown said that the Powell Duffryn property was ideal for complete electrification. The greatest drawback was the low average power factor, due largely to the enforced use of low-speed motors of great overload capacity. In the case of the Aberdare Valley the average was between .7 and .85, probably nearer .7 in cost cases. This was inevitable in colliery work, owing to the necessity of having haulage motors of ample capacity for their work. These motors usually represented a large proportion of the total load. Static condensers could be used in the case of small motors to keep the power factor at its maximum value at practically all loads and speeds, and in the case of large motors running under very steady load, the phase advancer could be used. The disadvantages of the phase advancer were that it could not be kept in circuit on starting or reversing, and that the amount of leading wattless current was unduly large in proportion to the motor load. These disadvantages effectually barred its use in connection with haulage motors, and the best method appeared to be the installation of a synchronous condenser. A simple calculation would show that the so-called wattless load of the Powell Duffryn Co. represented a capital value of several thousand pounds, and if to this was added the probable cost of generator and transformer capacity to deal with this load, the total would be astounding and would demonstrate the fact that an investment in plant for improving the power factor on transmission lines would be a sound financial proposition.

Mr. H. W. Edmondson said, referring to portable lamps, that half-watt lamps would probably be used, but not in the near future. The exact voltage conditions under which portable lamps would be used should be ascertained in order to ensure efficient working.

Mr. S. J. Watson said that as far as electrification of collieries in Lancashire was concerned, practically the whole field had got to be attacked. Gas engines were a thoroughly good proposition at a centre where coke ovens were installed. It would be of interest to know why on a transmission line only nine miles long, it had been necessary to step up from 10,000 to 20,000 volts.

Dr. G. W. Worrall referred to earth resistance tests which he had superintended at a large group of collieries. The conductivity of the earth return varied from about 1 to 2½ times the conductivity of the cable. The result depended upon the size of cable, and also took account of joint boxes and switchgear which were installed. Regarding the resistance of earth plates, some tests carried out by him using two auxiliary earth plates showed a resistance slightly under one ohm. Colliery managers seemed to think that when installing a 20 or 30-h.p. haulage motor, it was simply necessary to cut a hole in the side of the shaft and put the motor there. Open fuses and switchgear which did not conform to Home Office regulations were frequently met. The engineer of a very large group of collieries advocated the abolition of all starting gear underground; specially designed motors of about 40 h.p. were switched direct on the mains, and the results were stated to be very satisfactory. He suggested that miners' lamps should be fitted with reflectors instead of leaving the lamps open; this would enable anyone following the bearer of the lamp to see ahead much better. Leather thongs for suspending cables were usually eaten away by rats and had to be replaced by zinc thongs.

Mr. C. Day said the utilisation of exhaust steam had grown enormously, one company having supplied over one hundred plants for this purpose. The problem of condensing plant in collieries was a difficult one; corrosion and sediment problems were common, and it seemed quite the thing that jet condensing plant rather than surface plant with tubes should prevail. Taking 100 cases in his experience, only one-fourth were surface condensing, the remainder being of the jet type. Corrosion was more prevalent with the very high speeds of rotation than with the lower speeds; it was a distinct fact that a centrifugal pump run at 3,000 revs. would be more likely to show corrosion than if run at 1,000 revs. Therefore, if small steam turbines were used for driving these pumps it would seem better to drive through gears and keep the speed of the pump down.

Mr. Nelson considered the question of colliery staff very important. Colliery plant was installed and when running all right was handed over to a man who, in view of the small size of the colliery, could not be adequately paid and therefore could not have the experience to deal with such a valuable collection of machinery. This point alone warranted the supply being taken from a company. Regarding motors, he advocated the specification of a certain air gap, as in many cases very high efficiencies and high power factors were demanded necessitating small air gaps, with consequent trouble due to slight wear of bearings. There was considerable room for improvement in the arrangements for easily and speedily removing connecting cables from portable haulage motors and the operating gear.

Mr. E. C. McKinnon said regarding positive battery plates it was stated that the original lead type lasted about nine months; assuming six charges per week this would work out at about 200-250 charges. The life of the plate was affected by too much charging, but the deterioration could be decreased by the use of celluloid separators between plates. Care of the positive plate would give at least 600 charges instead of the present maximum of 250.

Mr. W. Cramp said it was difficult to realise how it would pay a colliery to buy its current unless the colliery were very small. Comparative figures would be interesting, even if actual figures were withheld. The author had stated that trouble had arisen due to pre-ignition, and for that reason the powers of the gas engines were reduced; there appeared to be other means of overcoming this trouble. The compression could be reduced, which would enable the gas engine to work again up to its full power. Another arrangement was to draw in with the air a certain amount of the exhaust gases ejected from the cylinder, which reduced the richness of the mixture and prevented pre-ignition. It had always been a puzzle to know why for 1,000 k.v.a. units the low-speed engine was adopted at all. The cost per kw. was particularly greater than that of the high-speed vertical engine; in fact two vertical sets could almost be bought for the price of one horizontal set. Besides the engine cost, there was the enormous cost of low-speed generators compared with the small cost of direct-driven high-speed generators. A third and not altogether negligible factor was that the high-speed vertical engine was a home product and could be built and repaired here. For the air filter a pressure of 4 in. or 6 in. of water produced by the fan was quite unnecessary; an inch at most should be sufficient.

Mr. Sparks said that one point in the paper was unanimously approved in London and at the Local Sections, viz., the earthing of the neutral. Mr. Anderson had shown how by careful design and good construction earth resistances of 3.8 and 1.48 ohms could be obtained. He desired to impress upon all members the fact that this earthing matter could not be dealt with haphazard, because, after all, the earth connection was intended to be the main safety point. The sheathing could not be relied upon, and in the paper an actual conductor was advocated. The author advised a number of smaller collieries not so favourably situated as Powell Duffryn, and it appeared simpler for them to purchase from power companies the moderate amount of energy they required. He did not know of a power company which could supply such an undertaking as the Powell Duffryn. Mr. Edmondson's remarks regarding lamp voltage embodied an exceedingly valuable suggestion; it was often overlooked that what appeared in itself a small variation in voltage was a large percentage when dealing with a 2-volt lamp. They had started with a surface condenser, but owing to the large amount of oil, etc., coming from the winding engine, and through the low-pressure system into the condenser, the difficulty of maintaining a good head with surface condensing was very great, and in the latest adaptation a jet condenser had been used. Mr. Day's recommendation of the jet condenser was absolutely right, as surface condensing was too difficult a problem to keep up. When the winder-house was put up it was in-

tended to put in one electric crane, but as it was required to erect the plant quickly, it was arranged to build the workshop exactly the same width as the winder-house, as it only meant altering the building by a foot or two. The original two cranes were therefore available for the winder-house during erection, and subsequently one of the cranes was transferred to the pump-house. The scheme saved an enormous amount of time and money. For many years he had always demanded in specifications to have the air gap dimensions of the motor. There was a reason why vertical gas engines had been ignored. It was desired at the start to go in for a unit of about 1,500 KW., and at that time, eight years ago, it was quite incredible that a firm should consider a high-speed unit delivering anything like 1,500 KW., and although there was some approval of the proposal, no bids could be obtained for a unit of this size. This was the reason for the low speeds. Improvement in power factor was attained by working at a fixed pressure. Motors designed to give good results at 3,000 volts would have a good power factor at 3,000 volts, but if the voltage was 2,900 or appreciably over 3,000, the power factor would be bad.

IMPORTS OF HOLLAND.

THE following figures showing the imports of electrical and similar goods, for consumption, into Holland during the year 1913, are taken from the recently-issued official trade statistics; the figures for 1912 are added for purposes of comparison, and notes of any increases or decreases are given.

	1912. Gulden.	1913. Gulden.	Inc. or dec. Gulden.
Machinery, steam, industrial and agricultural.—			
From Belgium	3,342,000	3,690,000	+ 348,000
,, Great Britain ...	8,195,000	11,062,000	+ 2,867,000
,, Hamburg	176,000	236,000	+ 60,000
,, Germany	24,334,000	29,036,000	+ 4,702,000
,, United States ...	3,653,000	4,758,000	+ 1,105,000
,, Other countries ...	466,000	798,000	+ 332,000
Total	40,166,000	49,580,000	+ 9,414,000
Gutta-percha, raw.—			
From France	132,000	333,000	+ 201,000
,, Great Britain ...	163,000	174,000	+ 11,000
,, Dutch Guiana ...	885,000	1,959,000	+ 1,074,000
,, Java, etc.	4,772,000	1,650,000	− 3,122,000
,, Other countries ...	230,000	237,000	+ 7,000
Total	6,182,000	4,353,000	− 1,829,000
Gutta-percha manufactures.—			
From Belgium	379,000	578,000	+ 199,000
,, Great Britain ...	202,000	156,000	− 46,000
,, Germany	372,000	402,000	+ 30,000
,, Other countries ...	21,000	1,000	− 20,000
Total	974,000	1,137,000	+ 163,000
Iron wire.—			
From Belgium	3,591,000	3,785,000	+ 194,000
,, Great Britain ...	25,000	21,000	− 4,000
,, Germany	28,313,000	86,486,000	+ 58,173,000
,, Sweden	294,000	546,000	+ 252,000
,, Other countries ...	15,000	23,000	+ 8,000
Total	32,238,000	90,861,000	+ 58,623,000
Instruments, physical, chemical, etc.—			
From Belgium	711,000	810,000	+ 99,000
,, Great Britain ...	607,000	547,000	− 60,000
,, Hamburg	53,000	401,000	+ 348,000
,, Germany	6,425,000	7,639,000	+ 1,214,000
,, Other countries ...	219,000	149,000	− 70,000
Total	8,015,000	9,546,000	+ 1,531,000
Copper wire.—			
From Belgium	166,000	211,000	+ 45,000
,, Great Britain ...	107,000	152,000	+ 45,000
,, Hamburg	205,000	6,000	− 199,000
,, Germany	2,995,000	4,038,000	+ 1,043,000
,, Other countries ...	64,000	80,000	+ 16,000
Total	3,537,000	4,487,000	+ 950,000
Steel wire.—			
From Belgium	474,000	866,000	+ 392,000
,, Great Britain ...	801,000	909,000	+ 108,000
,, Germany	867,000	5,283,000	+ 4,416,000
,, Other countries ...	43,000	118,000	+ 75,000
Total	**2,185,000**	**7,176,000**	+ 4,991,000
India rubber manufactures.—			
From Belgium	1,780,000	2,343,000	+ 563,000
,, Great Britain ...	2,139,000	8,548,000	+ 3,321,000
,, Java	5,239,000	2,917,000	+ 778,000
,, Germany	55,000	115,000	+ 60,000
,, Russia	634,000	1,273,000	+ 639,000
,, United States ...	117,000	91,000	− 26,000
,, Other countries ...	804,000	791,000	− 13,000
Total	10,756,000	16,078,000	+ 5,322,000
Glass manufactures.—			
From Belgium	327,000	330,000	+ 3,000
,, Great Britain ...	115,000	141,000	+ 26,000
,, Germany	2,131,000	2,303,000	+ 172,000
,, Other countries ...	18,000	18,000	—
Total	2,591,000	2,792,000	+ 201,000
Porcelain.—			
From Belgium	188,000	224,000	+ 36,000
,, Great Britain ...	107,000	94,000	− 13,000
,, Germany	1,388,000	1,577,000	+ 189,000
,, Other countries ...	82,000	112,000	+ 30,000
Total	1,765,000	2,007,000	+ 242,000

NOTE.—Gulden = 1s. 8d.

UTILISATION OF WATER-POWER.

IN a paper read recently by MR. ARTHUR SURVEYER, before the CANADIAN SOCIETY OF CIVIL ENGINEERS, the author dealt with the question of making Canadian water-powers valuable, and incidentally touched on electrochemical and metallurgical developments in connection with hydro-electric power. A brief abstract of his paper is as follows :—

The following table has been compiled from various European sources, from the reports of the United States Geological Survey and from the report of the Canadian Commission of Conservation. It shows the total available and developed water-powers in the different countries of Europe, in the United States, and in the various Provinces of Canada ; it also indicates the percentage of utilisation for each country and the horse-power per sq. mile.

TABLE I.

	Hydraulic power available on turbine shafts. Available. Thousand H.P.	Developed. Thousand H.P.	Percentage of utilisation.	Available power per square mile.
EUROPE			Per cent.	H.P.
Great Britain ...	963	80	8·3	1·00
Germany	1,425	445	31·2	1·18
Switzerland	1,500	380	25·0	3·71
Spain	5,000	300	6·0	3·86
Italy	5,500	565	10·2	4·22
France	5 857	650	11·1	5·80
Austria-Hungary ...	6 460	515	8·0	7·34
Sweden	6,750	550	8·2	7·72
Norway	7,500	920	12·3	14·12
	40,955	4,405	10·6	5·44
NORTH AMERICA				
United States ...	26,736	4,016	15·0	7·49
CANADA				
Saskatchewan ...	20	—	0·2	·19
Alberta	71	7	9·8	·69
Nova Scotia	83	15	18·0	3 93
New Brunswick ...	280	10	3·6	10 03
Manitoba	410	48	11·7	6·37
British Columbia ...	1,100	101	10·1	2·81
Ontario	3,400	504	14·8	15·41
Quebec	5,600	328	5 8	16·38
North West Territories	6,900	—	0·0	3 19
	17,764	1,013	8·2	6 55

The data contained in this table refer to conditions in the year 1911, and the provincial areas used to calculate the figures of the last column are taken from the Canadian Atlas of 1906.

It would have been more interesting if complete figures for 1914 had been available. Unfortunately, nothing authentic could be obtained except in a few instances. The inclusion of the new Shawinigan development, the Canadian Light & Power Co.'s plant, and the large development at Cedars would raise the figures for the Province of Quebec to over 500,000 developed horse-power. Switzerland's present figures are about 550,000 H.P., Norway's over

1,000,000 H.P., and those of the United States between 5,500,000 and 6,000,000 H.P.

It is probable that the data concerning Europe and the United States are fairly accurate, whilst the Canadian figures are based on doubtful information. The Conservation Commission of Canada in its report of 1911 did not "consider advisable to make an estimate of the total water-power in Canada," adding, "one estimate places it at nearly 17,000,000 H.P.; but it does not, and cannot, rest upon any basis of reliable information."

Table II and Table III refer more closely to the subject of this paper and supplement to a great extent the information given in Table I.

TABLE II

Provinces.	Developed power.	Sub-division of developed power.		
		Electrical energy.	Pulp and paper.	Various Industries.
	H.P.	H.P.	H P.	H.P.
Ontario	504,000	394,000	46 000	64 000
Quebec	328,000	198,000	88,000	42,000

Table II has been compiled from the report of the Canadian Commission of Conservation, and details the uses made of the developed water-powers in Ontario and Quebec. It should be noted that 74,000 electrical H.P. are exported from Ontario to the United States at Niagara Falls, and this amount is, therefore, not included in Table III.

Table III indicates the uses made of the *hydro-electric* energy generated in Ontario, in Quebec, in France, in Sweden, and in Norway. The data for the Provinces of Ontario and Quebec were taken from a paper by Mr. Watson Bain on the "Electrochemical Industries in Canada." The figures for the other countries refer to conditions previous to 1910, and have been compiled from different statistics. The conclusions resulting from the examination of Table III are that up to the present we have only progressed in the more simple applications of electricity, and that we have practically neglected its utilisation as an electrolytic agent and as a heat generating agent in electrochemistry and electrometallurgy.

TABLE III.

Countries.	Developed hydro-electric power.	Sub-division of developed power.			
		Electro-chemistry and electro-metallurgy.		Motive power, Traction and lighting.	
	H.P.	H.P.	%	H.P.	%
France ...	592,000	291,000	49·1	301,000	50 9
Norway ...	543,000	275,000	50·6	268,000	49·4
Sweden ...	370,000	120,000	32 4	250,000	67·6
Ontario ...	320,000	25,000	7 8	295,000	92·2
Quebec ...	198,000	28,000	14·1	170,000	85·9

It is self-evident that the consumption of electricity for lighting or for traction depends on population. Neglecting the Montreal market, which is exceptional, the consumption of electricity *per capita* either for lighting or for traction is too small to be considered as an inducement to the extensive development of our waterfalls. A Western statistician gives the consumption of electricity in small towns as, roughly, one-tenth of a horse-power per inhabitant, so that a plant of 1,000 H.P. would, on this basis, be sufficient to supply the requirements of a town of 10,000 population. On the other hand, the smallest electrochemical or electrometallurgical industry consumes more than 1,000 H.P. Plants of 10,000 H.P. are numerous, and those of over 30,000 H.P. are by no means exceptional.

The pulp and paper industries are also great users of power, but we in Canada are not so very far behind in this phase of development, although Sweden utilises over 120,000 H.P.

An improvement in the situation might be brought about by attracting to Canada more electrochemical and electro-metallurgical industries, thereby causing a notable increase in the development of our water-powers. It has been thought advantageous to briefly review some of the industries which, either on account of the abundance of the necessary raw materials, or because of the large neighbouring markets, might be likely to prosper in Canada.

Electrochemistry.

Calcium Carbide.—The calcium carbide industry was started in 1895, with Mr. Wilson, of Ottawa, as one of the pioneers. There are now over 70 plants situated all over the world capable of absorbing 360,000 H.P. in their operation. The world's production for 1910 was 250,000 tons; it was 300,000 tons in 1912, and increased to 340,000 tons in 1913.

One special feature of the carbide industry is that many of the producing countries are not users of the product, and that the centres of consumption are located in places where it is impossible for want of waterfalls to manufacture carbide.

Germany, England, Australia, and the South American Republics are the importing countries; the consumption of Germany has increased five-fold in the last 14 years, having risen from 11,000 to 55,000 tons annually. The exporting countries are Sweden, Norway, Switzerland and the United States. The production of the United States in 1913 was 70,000 tons, with an export trade of 15,000 tons. The American exports go to South and Central America, where the demand for acetylene for house lighting is rapidly increasing.

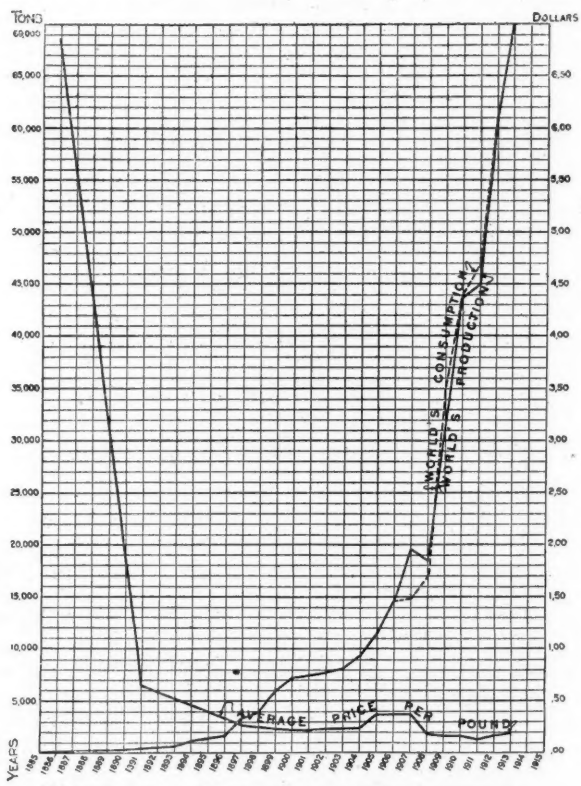
Nitrate of soda, or Chile saltpetre, is the best known of the imported fertilisers; it is found in its natural state in immense deposits situated in Chile, Peru and Bolivia. The curve gives an idea of the phenomenal increase in the world's consumption.

Nitrate of Lime.—Nitrate of lime was not at first received with favour by the farmers on account of its hygroscopic properties which demand the immediate use of the whole contents of a barrel once it has been opened. However, outside of this inconvenience, nitrate of lime has been proved entirely superior to the Chilian nitrate of soda, and its consumption as a fertiliser has increased rapidly.

The manufacture of synthetic nitrate of lime has only been carried out so far in Norway by the Norwegian Nitrogen Co., and its subsidiary companies, grantees of the Birkeland and Eyde and Schonnherr patents.

The chemical fertilisers manufactured at Notodden are nitrates of lime, of potash, of ammonia, of phosphate of ammonia, and of biphosphate of lime; this industry produces also nitric acid and nitrite of soda. The production of nitrate of lime was 9,500 tons in 1909, and it is estimated that the production in 1915 will be about 160,000 tons.

The Norwegian Nitrogen Co. and its subsidiary companies have undertaken, solely for the needs of this industry, the construction of a number of hydro-electric plants, the total capacity of which will reach the enormous figure of 540,000 H.P. There are at present four plants of approximately 180,000 H.P. in operation, with two others totalling 160,000 H.P. in course of construction.



Production, Consumption and Average Price of Aluminium.

The world's yearly consumption of nitrate of soda is approximately 2,500,000 tons; but the Chilian saltpetre is not utilised solely as a fertiliser, it is also employed in the manufacture of powder and nitric acid. It is generally acknowledged that industry does not absorb more than $\frac{1}{3}$ or $\frac{1}{4}$ of the total production of nitrate of soda.

Mr. E. F. Côte, a well-known French economist and engineer, after having analysed the progress of the different Norwegian industries in 1912, expressed the following opinion concerning the future of the manufacture of nitrate of lime:—

"Four hundred thousand horse-power with the efficiency mentioned above would probably produce 250,000 tons of nitrate. But what is this? Chile exports every year 2,000,000 tons of natural nitrate to Europe; in 10 or 15 years the Norwegian nitrate plants will have attained their full development; but their production then will not be sufficient to take care even of the increased consumption. It is certain, on the other hand, that the Chilian beds will not be able to indefinitely supply the rapid and continuous increase of the demand, and it will be necessary for industry to develop its own means of production in order to satisfy the urgent need for nitrogen of the bread-eating nations. This means that the market for nitrogenised fertilisers is practically unlimited and that is why the capitalists have given their backing to the electro-

synthetic processes with a spontaneousness which has only been equalled by their boldness."

Limestone is the only raw material required in the manufacture of nitrate of lime, the economical production of which is entirely dependent on the cost of the electrical energy. In Norway, the cost of production of nitrate of lime is very much below the selling price of Chile saltpetre.

Nitric Acid.—Synthetic nitric acid is chiefly obtained by the Pauling process, which is similar in principle to the Birkeland and Hyde, and Schonnherr processes.

The Pauling furnaces are used in Austria-Hungary, at Patsch, near Innsbruck: there are 24 furnaces absorbing 15,000 H.P. Another plant of 8,000 H.P. operates the Pauling process in the north of Italy, whilst in France, the Roche-de-Rame works near Briançon, have utilised 8,000 H.P. since 1908, and will ultimately use 20,000 H.P.

Nitric acid manufactured synthetically is very pure, and is free from nitrous products, and from chlorine and sulphuric acid.

The world's production of nitric acid is from 200,000 to 250,000 tons per year, Germany producing about 100,000 tons, and the United States 70 000 tons per year. The margin between the selling price of ordinary nitric acid and the cost of synthetic azotic acid is large and indicates that this industry can afford to pay more for its electrical energy than the nitrate plants.

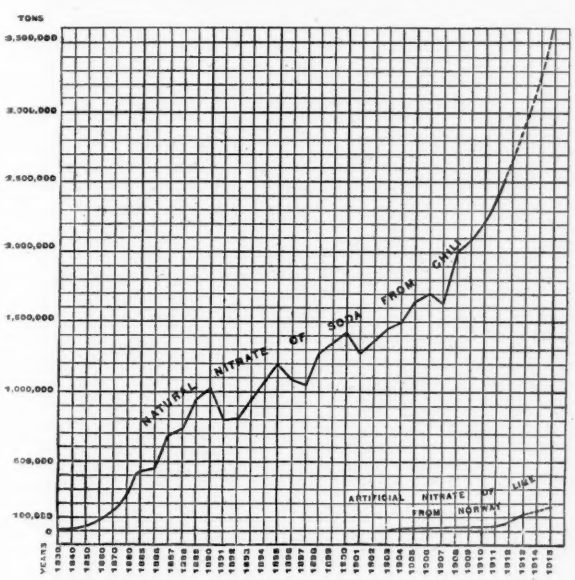
Calcium Cyanamide.—This is an artificial fertiliser containing carbon, nitrogen and calcium.

Electrical energy is used chiefly in the production of calcium cyanamide, which is the raw material, and which is transformed chemically into an azotised compound.

Calcium cyanamide is manufactured in 15 different plants located in France, Switzerland, Norway, Italy, Austria-Hungary and Japan. In addition, the American Cyanamide Co. has important works in the State of Alabama, and a plant at Niagara Falls on the Canadian side.

The world's production in 1911 was 110,000 tons, in 1912 was 153,000 tons and in 1913 reached 226,000 tons.

The Canadian plant began operation in January, 1910, with a



Production of Nitrates in Chile and Norway.

yearly capacity of 10,000 tons; in March, 1913, the production of the plant had been increased to 24,000 tons per year.

Aluminium.—This is manufactured by electrolysing alumina dissolved in a molten bath of cryolite, these materials being placed in an iron trough lined with carbon, and connected to the negative pole of a dynamo, while a carbon anode immersed in the charge is connected to the positive pole.

Alumina is obtained by refining bauxite; this ore is composed of impure hydrated alumina, and contains besides ferric oxide, silicon and titanium oxide. France and the United States are the countries rich in bauxite. In 1910 the world's production of bauxite was 271,000 tons, and of this total France had supplied 128,000 tons and the United States 129,000 tons.

In 1912 the United States produced 165 000 tons of bauxite, and imported 27,000 tons from France. They exported in the same year to Canada 10,000 tons of alumina or concentrated bauxite.

The cryolite employed in the metallurgy of aluminium is a double fluoride of aluminium and of sodium. The only known deposit is situated in Greenland, and belongs to the Danish Government. The export of this natural cryolite had reached 8,000 tons in the year 1911. However, the double fluoride of aluminium and sodium is now prepared artificially in France and in Austria; the raw material used in this manufacture is the fluoride of calcium called fluorspar, and the synthetic cryolite is considered a much better product than the natural cryolite of Greenland.

Since 1886 the increase in the world's consumption of aluminium has been phenomenal. The chart shown indicates this rapid rise, and also shows the corresponding drop in the selling price of the metal.

The manufacture of aluminium was towards 1890 in the hands of five companies, who raised the production of aluminium from 175 tons per year to 7,300 tons during the period from 1870 to 1890. In 30 years the average price of aluminium decreased from $1 a lb. to $0.22 a lb. in 1900.

The price of $0.22 per lb. did not leave a very great margin of profit, so that in 1900 the five companies amalgamated into an international syndicate to regulate the production and the selling price of aluminium.

This combine caused an immediate rise in the quotations, but in 1907, the patents for the manufacture of aluminium having become public property and the price of copper having fallen very low, the production of aluminium became much larger than the demand for it. This was followed by a crisis, which brought about the dissolution of the aluminium syndicate in 1908.

In April, 1911, a new alliance was formed between the different manufacturers of aluminium. The object of this combine was to regulate the selling price, to put a stop to the cut-throat competition which had existed since 1908, and to work for the constant enlargement of the market for aluminium.

The extraordinarily low prices of aluminium have resulted in the popularising of the use of the metal and the increase in its consumption in a remarkable manner, so that a return to normal conditions will leave the manufacturers who have been able to face the crisis with a market for their product definitely enlarged and continually increasing.

In 1912 the United States produced 18,000 tons of aluminium, France 13,000 tons and Canada 9,000 tons.

Zinc.—The production of zinc by the electro-thermic process has been undertaken chiefly in Sweden and Norway. At Trollhattan in 1912 11 furnaces produced 3,228 tons; the plant is to be enlarged to 17 furnaces of 1,000 H.P. each and eight of 500 H.P. each, giving a total installed capacity of 21,000 H.P.

Two Norwegian plants produced 8,900 tons in 1912; and at Vancouver the Canada Zinc Co. is supposed to be operating several Snyder furnaces for the electro-thermic treatment of zinc.

Nickel and Copper.—Drs. Haanel and Héroult have experimented at Sault Ste. Marie, and think it would be possible to obtain commercial ferro-nickel pig by the electro-reducing process.

In 1910 the total power used by aluminium works was over 320,000 H.P., of which 140,000 H.P. was developed in France.

The actual capacity of the plants of the Aluminium Co., of America, is 90,000 H.P., and this company has signed a contract for the purchase of 60,000 H.P. for use at its Messena Works on the St. Lawrence.

The Shawinigan Falls plant of the Northern Aluminium Co. has a capacity of 20,000 H.P. A French company, the Southern Aluminium Co., has started at Whitney, N.C., the construction of a 70,000 H.P. hydro-electric plant, with furnaces, &c., which was to be in operation early this year.

The Government of Chile has also been making extensive experiments in France on the industrial production of copper, and hopes to be able to effect a reduction of 75 per cent. in the cost of its production by means of the electric furnace.

Production of Pig-Iron by the Electric Furnace.—In 1906, the Canadian Government authorised Dr. Haanel to experiment on the reduction of ore in the electric furnaces known at the time. The experiments were followed by experiments in Sweden extending over several years. At Domnarfvet, the tests took place between 1907 and 1909, and were made with several small furnaces which had been invented by three Swedish engineers.

The Swedish Association of Iron Masters considered that the results of the operation of the Gronwall furnace were good enough to warrant the construction in 1910 of a complete experimental plant at Trollhattan near the Government's hydro-electric plant. The Trollhattan experiments were continued until September, 1911, and were made in a furnace of 3,000 H.P. The new electric blast-furnace of Domnarfvet is of 12,000 H.P. and should produce 100 tons of pig-iron per day.

Iron ores are smelted by the electro-thermic process in California, in Italy, in Norway and at many places in Sweden. The production of electric pig-iron in this last country was 122 tons in 1900 against 17,600 tons in 1912. The world's production in 1912 was approximately 25,000 tons.

The Noble Electric Steel Co., of California, has in operation three furnaces of a total capacity of 8,000 H.P. There are in Scandinavia 20 furnaces absorbing over 36,000 H.P.

Ferros.—The name "ferro" is used to designate special varieties of pig-iron which are used as a final adjunct in the metallurgy of steel. These are ferro-manganese, ferro-silicon, ferro-chrome, ferro-molybdenum, ferro-tungsten and ferro-titanium. The pigs produced in the electric furnace are expensive products of high quality. In 1910, according to the statistics of "l'Industrie Minérale" the average value of ferros produced in the electric blast furnace was $21.00 per ton, whilst the ferros of the ordinary blast-furnace was sold at $2.00 per ton.

Ferro-Silicon.—Ferro-silicon is used in the converting of pig-iron for the production of steel. The world's production is over 100,000 tons of ferro-silicon per year. Two Canadian companies manufacture this product: The Lake Superior Power Co., at Sault Ste. Marie, with an electric furnace of 250 H.P., and the Electric Metals Co. at Welland, operating four furnaces of a total capacity of 5,000 H.P.

Ferro-Titanium.—The manufacture of ferro-titanium in the electric furnace is particularly interesting on account of the large deposits of titanium ore in the Province of Quebec. The United States' production of ferro-titanium for the year 1912 has been

estimated at 3,763 tons and nearly 600,000 tons of titanium-treated steel have been manufactured, as against 400,000 tons in 1911.

Production of Steel in the Electric Furnace.—The electric furnace used for the production of high and medium grade steel has so many advantages over the other furnaces that its general use appears absolutely certain in the very near future.

There are already more than 120 furnaces in operation in the world, and the production of electric furnace steel has risen from 33,000 tons in 1908 to 175,000 tons in 1912. Germany has tripled her production since 1910, and in 1913 had in operation 15 plants producing about 102,000 tons a year, placing her in the lead of the other countries. The United States, after having manufactured, in 1910, 52,000 tons, including a large quantity of electric furnace steel rails, is now awaiting the results of the use of these rails and is only turning out in the electric furnace special high-grade steels to the amount of 18,000 tons annually.

The electric furnace is also extensively used for melting steel for castings.

Conclusions.—The different industries which have been enumerated absorb approximately 1½ million hydro-electric horse-power, and Canada's contribution to this enormous utilisation of power is just about 3·5 per cent. of the total.

This paper can only be considered as a very brief survey of a very large field, and it would be rash to attempt to draw from it any definite conclusions. It is evident that all the industries mentioned above would not be sure of success in Canada, and that every particular case should be studied with the utmost care before trying to attract the investing public.

The great advantage of the water-powers of Sweden and Norway is the remarkable height of their falls and the consequent smaller volume of water required for the same power.

It would be possible on our navigable rivers to sub-divide the cost of development between navigation and industry. This would so reduce the cost of the industrial part of development that the unit cost of these low-head hydro-electric plants might compare with the figures of the Scandinavian developments. This Government help has been given to several plants in Europe and America and explains in a measure the apparently low cost of some of their enterprises.

There is no getting away from the fact, however, that the criticism of foreign engineers is partly correct. We are in a measure handicapped, and there are numerous obstacles, economical, educational and physical which interfere with the rapid development of our water-powers.

It is significant to note that the countries which have given the greatest number of years to the technical study of their water-powers have the highest percentage of utilisation: Germany, the Scandinavian countries, France and Switzerland, for example, were the first countries of Europe to undertake the systematic study of their rivers and falls, and these nations are now getting a greater return from their natural forces than the other countries.

It is only recently that such studies have been undertaken here. At present, the Canadian Public Works Department, the Department of the Interior, the Quebec Streams Commission, the Hydro-Electric Power Commission of Ontario, and the Province of British Columbia, have undertaken the scientific discharge measurements of some of our rivers, and have established gauges all over the country.

It is safe to say to-day, that through the lack of surveys, of discharge measurements and of gauge readings there are very few of our waterfalls which could be offered to oversea bankers.

The development of our water-powers has also been greatly handicapped by the difficulty in obtaining a clear title of ownership, and by the uncommerciality of some of the clauses contained in Government leases.

NEW PATENTS APPLIED FOR, 1915.

(NOT YET PUBLISHED).

Compiled expressly for this journal by Messrs. W. P. Thompson & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

4,045. "Electrical switches." A. P. Lundberg, G. C. Lundberg, P. A. Lundberg and G. Pegg. March 15th.

4,046. "Electrical switches." A. P. Lundberg, G. S. Lundberg, P. A. Lundberg and G. Pegg. March 15th.

4,054. "Electrical turning-gear for starting internal-combustion engines." F. H. Royce & Rolls-Royce, Ltd. March 15th. (Complete.)

4,076. "Storage-battery separators and process of making same." T. A. Willard. March 15th. (Complete.)

4,079. "Means for collectively actuating and controlling alternating-current motors." J. L. Routin. March 15th. (Addition to 735/13.) (Complete.)

4,083. "Electric clocks." F. O. Read & E. G. Thompson. March 15th.

4,087. "Means for regulating the voltage of dynamos." S. F. Tyler & W. J. E. Beere. March 15th.

4,090. "Carburettors." Electro-Generateur Gamma Soc. Anon. March 15th. (Convention date, March 16th, 1914, Belgium.) (Complete.)

4,097. "Production of Rontgen rays." J. E. Lilienfield. March 15th. (Convention date, November 15th, 1913, Germany.) (Complete.)

4,110. "Means for connecting electrical conduits to their fittings." F. L Broughton. March 16th.

4,130. "Interchangeable gas and electric light fittings." A. C. Eberhardt & E. A. Short. March 16th.

4,138. "Electric conductors, cables, and the like." H. Terry & Sons, Ltd., & C. Terry. March 16th.

4,144. "Oil circuit-breakers." F. B. Holt & H. Smith. March 16th.

4,172. "Associated internal-combustion engines and electric motors used in connection with the propulsion of water-craft." Wolseley Motors, Ltd., & A. A. Remington. March 17th.

4,190. "Thermostatically-controlled valve mechanism for steam traps, calorifiers, and the like." Royles, Ltd., J. J. Royle & G. E. Royle. March 17th.

4,203. "Controlling-mechanism for electric vehicles." British Thomson-Houston Co., Ltd. March 17th. (General Electric Co., United States.)

4,206. "X-ray plate-holder for absorbing secondary rays." A. O. Forder. March 17th.

4,209. "Rheostats." Igranic Electric Co., Ltd. March 17th. (Cutler-Hammer Manufacturing Co., United States.) (Complete.)

4,211. "Sparking-plugs for internal-combustion engines." A. Christmas. March 17th.

4,229. "Electrical coils and methods of winding the same." H. Wade. March 17. (J. R. Leeson, United States.) (Complete.)

4,230. "Winding-machines for winding electrical coils." H. Wade. March 17th. (J. R. Leeson, United States.) (Complete.)

4,239. "Synchronisation of phonograph and kinetograph." C. H. Verity. March 18th.

4,253. "Electric visual and audible signalling-appliances." H. Green & W. de Manoel Landon. March 18th.

4,263. "Air-cooled tanks for electrical apparatus." Babcock & Wilcox, Ltd. March 18th. (Babcock & Wilcox Co., United States.) (Complete.)

4,271. "Aero-electric combined marine and aerial torpedo." R. P. Williams. March 18th.

4,285. "Automatic telephone exchange systems." C. A. W. Hultman. March 18th. (Convention date, March 18th, 1914, Sweden.) (Complete.)

4,331. "Motor control." D. Murray. March 19th.

4,332. "Phonic wheel motor for distributors of electric telegraphs." D. Murray. March 19th. (Addition to 3,436/14.)

4,348. "Telegraphy." Eastern Telegraph Co., Ltd., & A. C. Gardiner. March 19th.

4,353. "Thermic telephones." Elektrotechnische Spezialkonstruktionen G.m.b.H. March 19th. (Convention date, March 24th, 1914, Germany.) (Complete.)

4,378. "Telegraphic printing apparatus." M. Balsera. March 20th.

4,401. "Rotary converters." M. Walker. March 20th.

4,411. "Vibrating reed and like apparatus for signalling, indicating, and other purposes." F. W. Lanchester. March 20th.

4,412. "Telephone and like apparatus." F. W. Lanchester. March 20th.

4,432. "Protective devices for alternating-current systems." British Thomson-Houston Co., Ltd., & E. B. Wedmore. March 20th.

PUBLISHED SPECIFICATIONS.

Copies of any of the Specifications in the following list may be obtained of Messrs. W. P. Thompson & Co., 285, High Holborn, W.C., and at Liverpool and Bradford; price, post free, 9d. (in stamps).

1913.

26,929. Method and Means for Comparing and/or Measuring Electrical Quantities. C. G. E. Milne, H. T. George, P. M. Levy and J. Tucker. November 22nd.

1914.

2,089. Electric Switches. British Thomson-Houston Co. January 26th. (General Electric Co.) (Cognate application, 11,943/14.)

4,470. Cases or Holders Especially Intended for Carrying Electrical Batteries upon Motor-cycles. A. S. West. February 20th.

4,627. Electric Lampholders and Reflectors. M. Chalier. February 23rd. (March 22nd, 1913.)

5,351. Electrical Train-controlling Systems for Railroads. H. J. Warthen. March 2nd.

5,354. Electrically-controlled Locks. L. Cadenel. March 2nd.

5,455. Protective Devices for Alternating-current Electric Generators. British Thomson-Houston Co. & E. B. Wedmore. March 3rd.

5,511. Electric Compound Transformers. B. Holm-Hansen. March 4th. (March 5th, 1913.)

5,513. Electro-magnetic Brakes, Clutches and the like. J. P. Hall & Co. and A. Nield. March 4th.

5,583. Method of Making Electrostatic Condensers. G. B. Burnside and Wallace. March 5th.

5,616. Make and Break Switches. R. Hacking and C. H. Hamley. March 5th.

5,890. Devices for Intermittently Making and Breaking Electric Circuits. R. G. Fyson. March 9th.

5,903. Communicating with Trains. H. A. Thompson. March 9th.

6,668. Means for Transmitting and Receiving Messages and Exhibiting Signals Electrically. T. D. Smith. March 16th.

6,739. Methods of and Means for Effecting the Combination of Gases. British Thomson-Houston Co. March 17th. (General Electric Co.)

6,853. Incandescent Electric Lamps. W. J. Owen and C. Damry. March 18th.

6,867. Combined Mechanical Support and Electrical Connection for Electric Fans. J. H. Collie. March 18th.

7,274. Electrostatic Separators for Sorting Out the Constituent Parts of Commodities according to their Electric Capacity. A. Bibolini and P. Riboni. March 23rd.

8,695. Electrical Connections. Soc. Anon. le Carbone. (April 7th, 1913.) April 6th.

10,733. Electric Light Switches Shining in the Dark. G. Santostefano della Cerda. May 1st. (June 5th, 1914.)

11,404. Electrical Condensers and the Manufacture Therefor. G. Giles. May 8th. (July 3rd, 1913. Addition to 10,895/14.)

11,881. Magnetic Compasses. M. B. Field. May 14th.

12,746. Electric Light Pendants. W. O. Teasdale. May 23rd.

14,548. Electric Switches. J. H. Tucker. (Divided application of 19,388/13. February 27th. Cognate application 16,045/14.) June 17th.

14,558. Sparking Plugs for Internal-combustion Engines. S. R. Jackaman. June 17th.

14,595. Mechanical Selector for Electromagnetic Waves to Wireless Telegraphic Receiving Apparatus. R. B. Goldschmidt. June 17th. (December 29th, 1913.)

14,884. Spark Gaps for Radio-telegraphy. E. Girardeau & J. Bethenod. (June 23rd, 1913.) June 20th.

15,798. Liquid Resistance Apparatus. H. Herapath & M. J. Railing. July 1st.

19,122. Electric Switches for Switchboards. C. H. Worsnop. August 27th.

19,944. Electric Railway and like systems. T. F. Mullaney. September 18th.

20,248. Electrical Resistance Thermometer. Cambridge Scientific Instrument Co. & W. H. Apthorpe. September 26th.

22,270. Construction and Arrangement of Self-induction Coils for use in Duplex Telephone Systems Operating on the "Pupin" Principle. A. H. Olsson and H. B. M. Pleijel. November 9th. (November 11th, 1913.)